

FIG. 1A

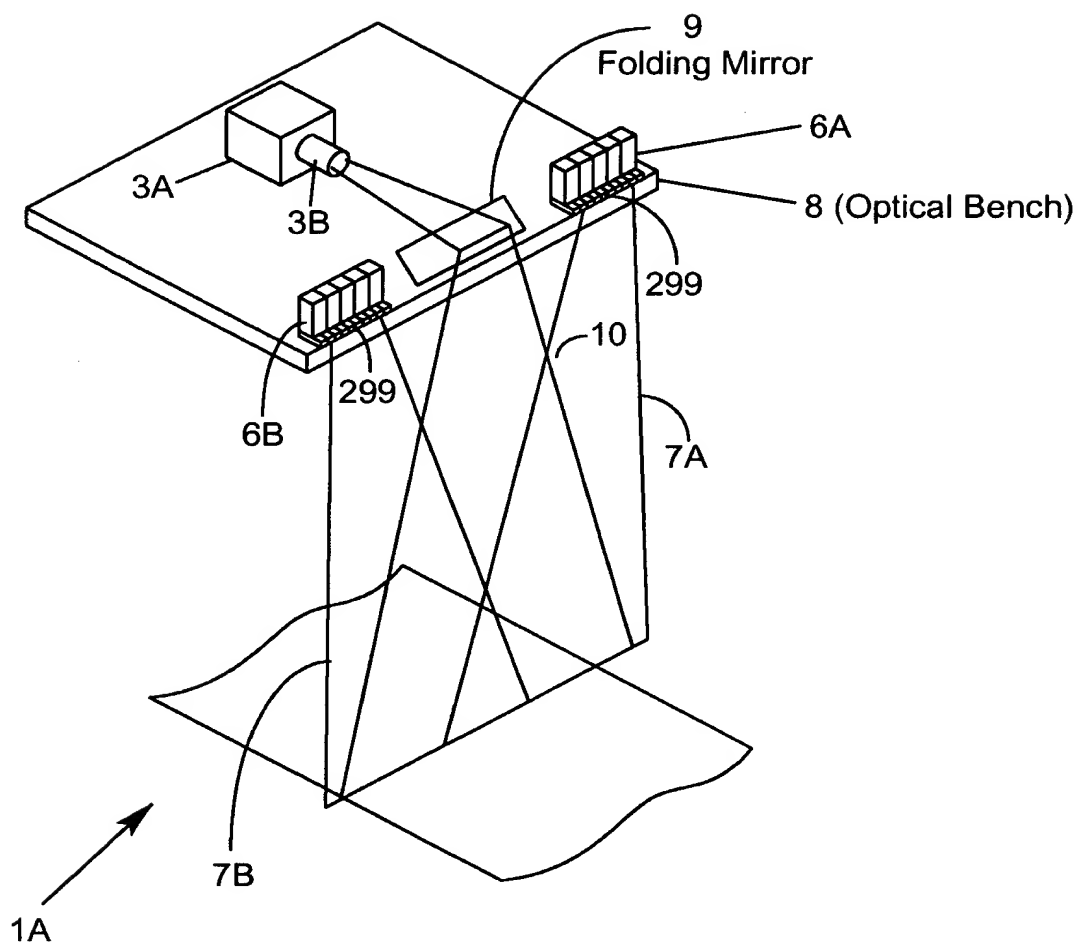


FIG. 1B1

FIG. 1B2

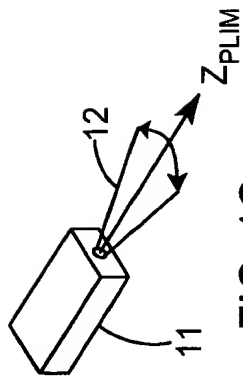


FIG. 1C

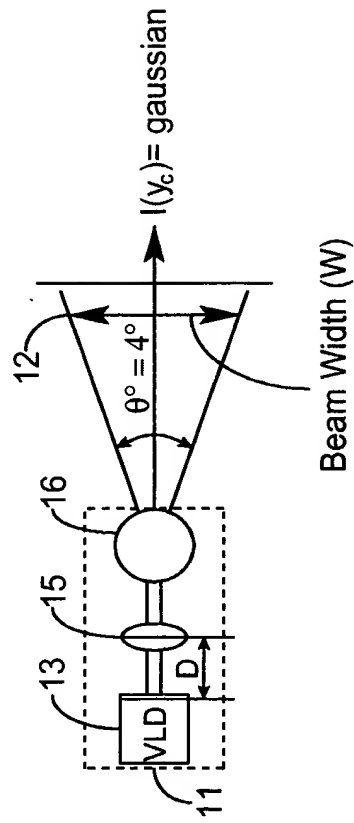


FIG. 1E1

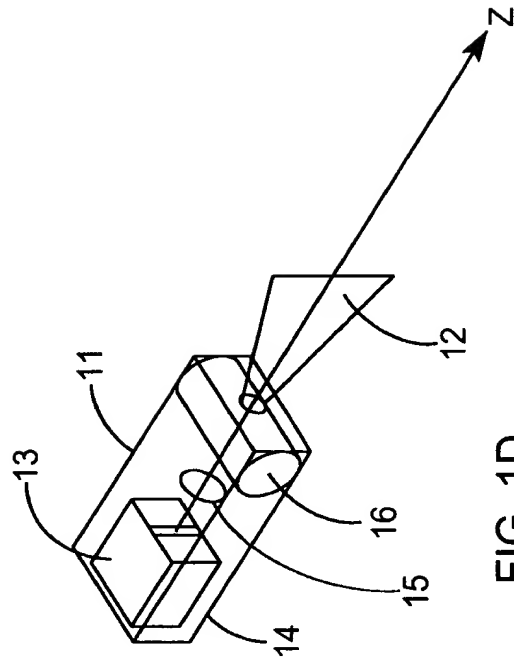


FIG. 1D

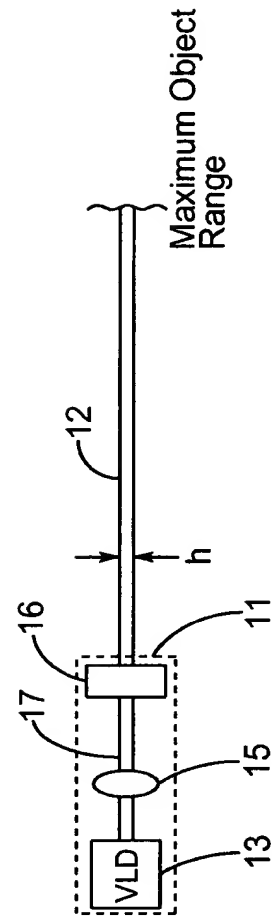


FIG. 1E2

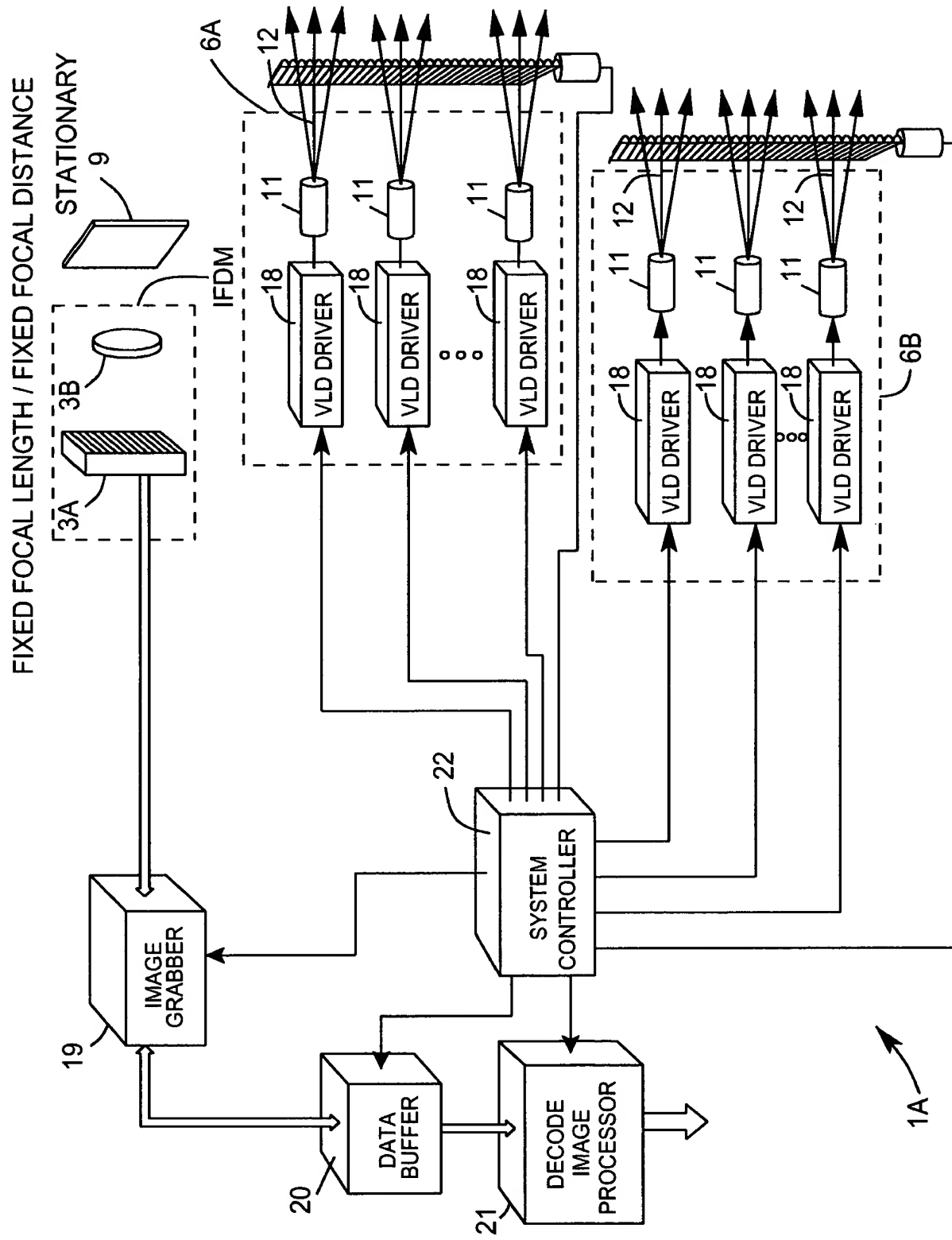
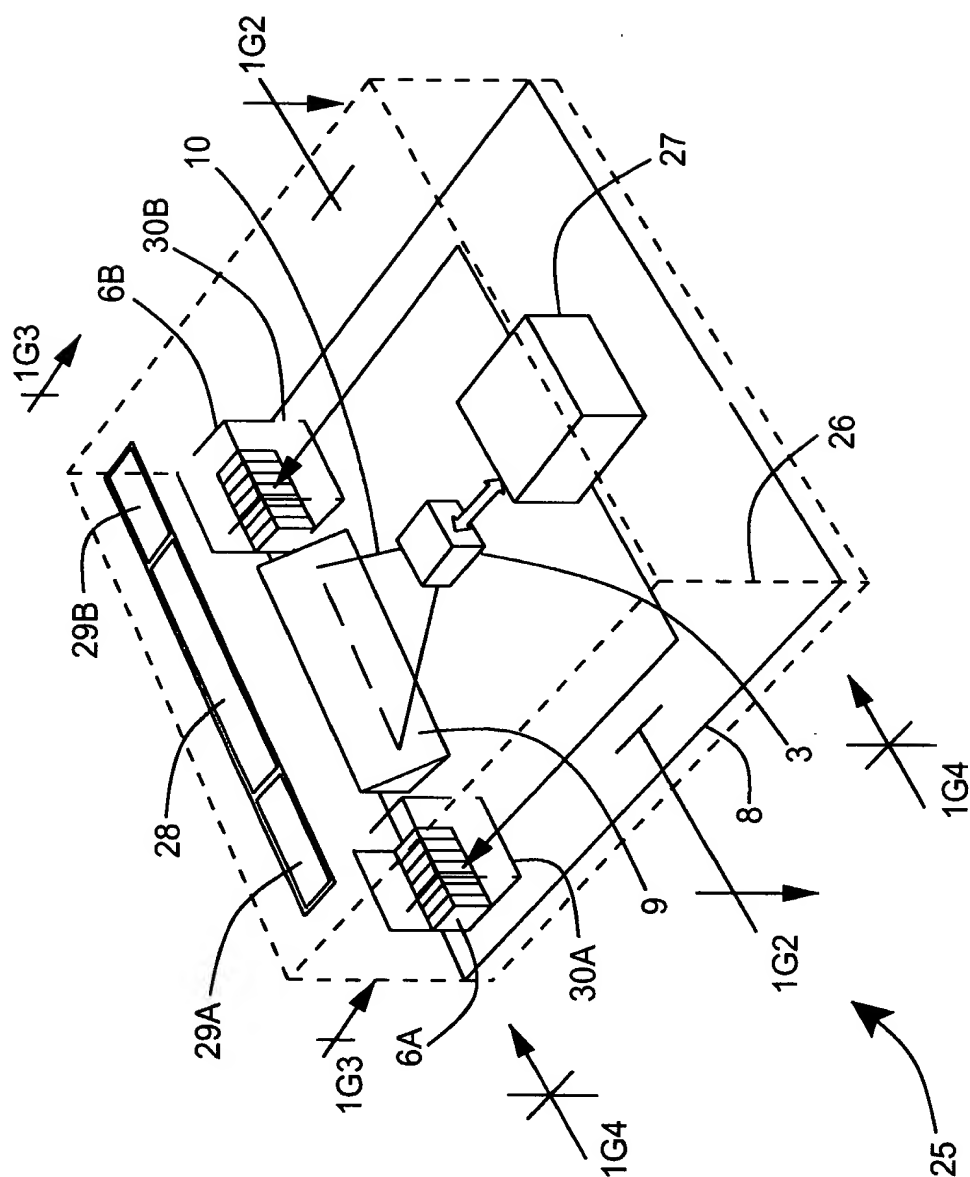


FIG. 1F



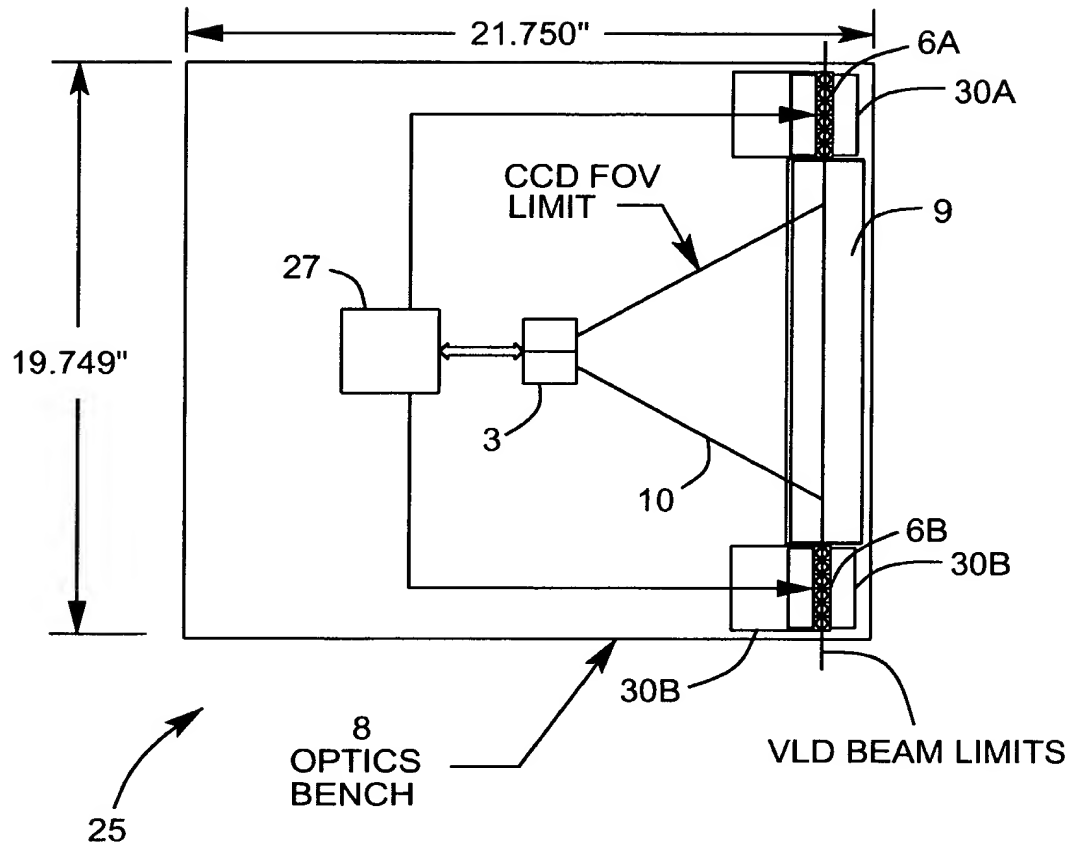


FIG. 1G2

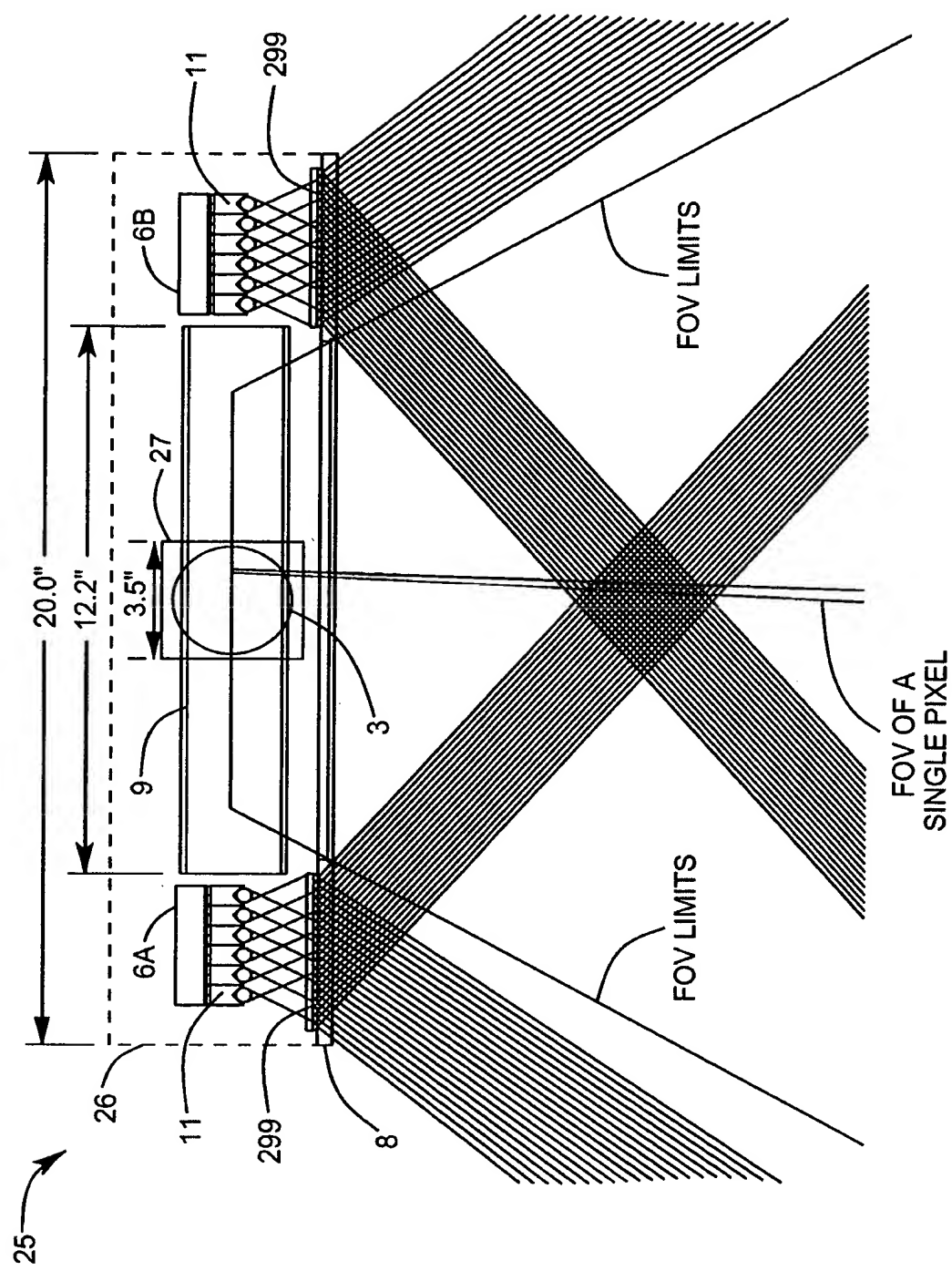


FIG. 1G3

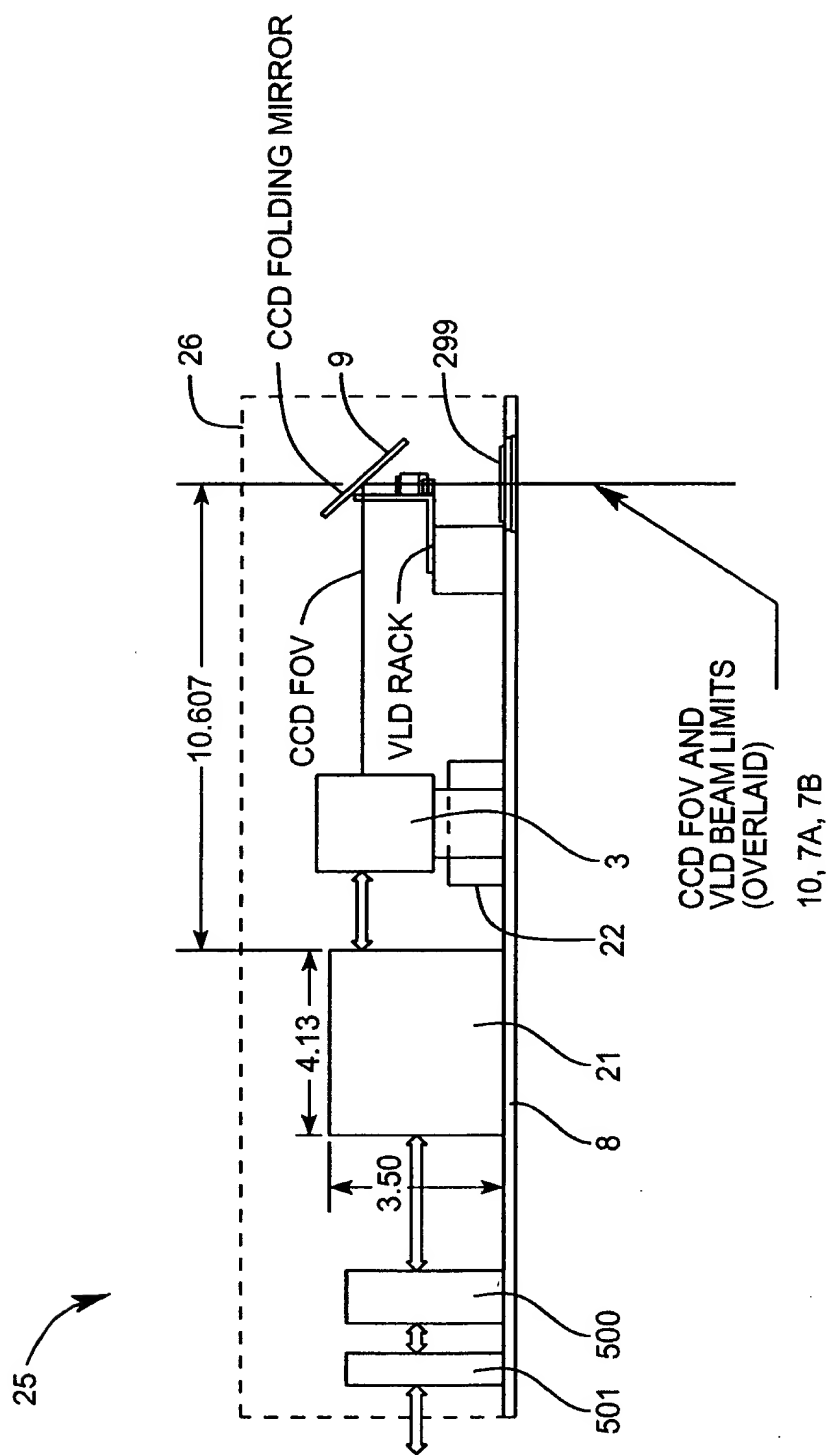


FIG. 1G4

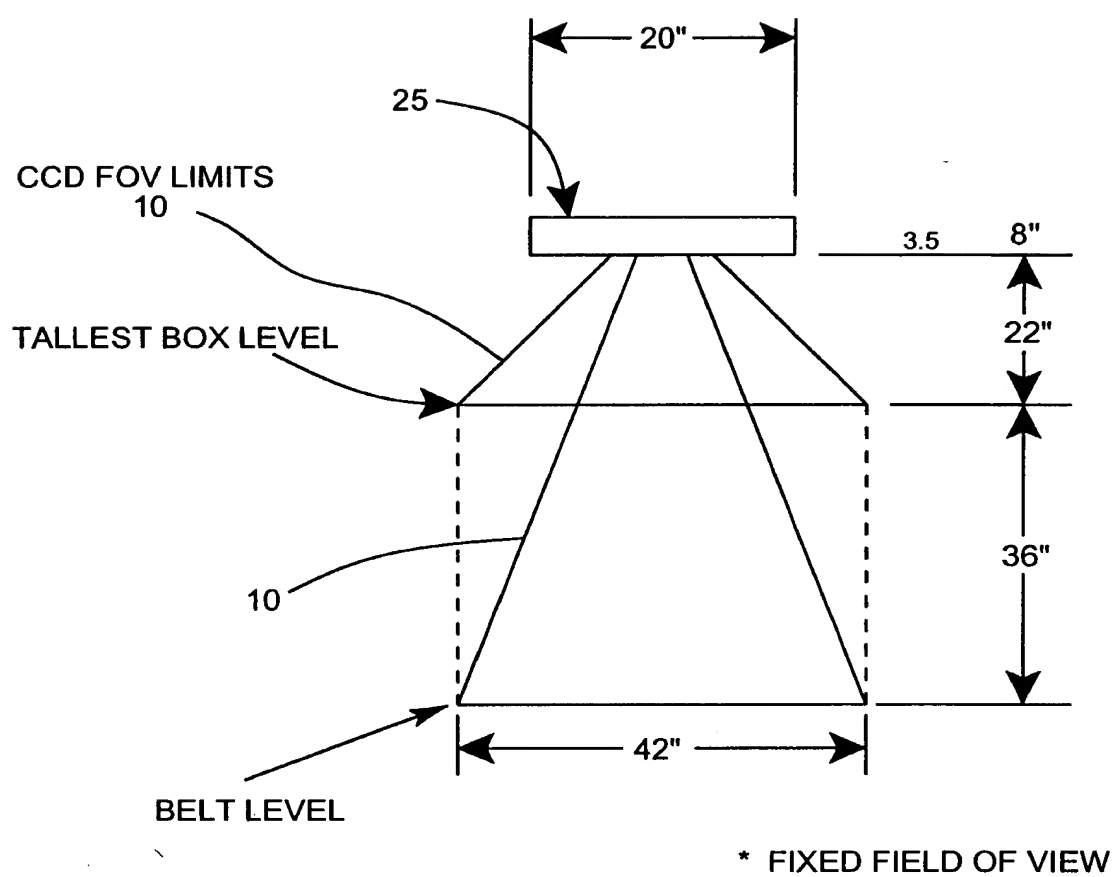


FIG. 1G5

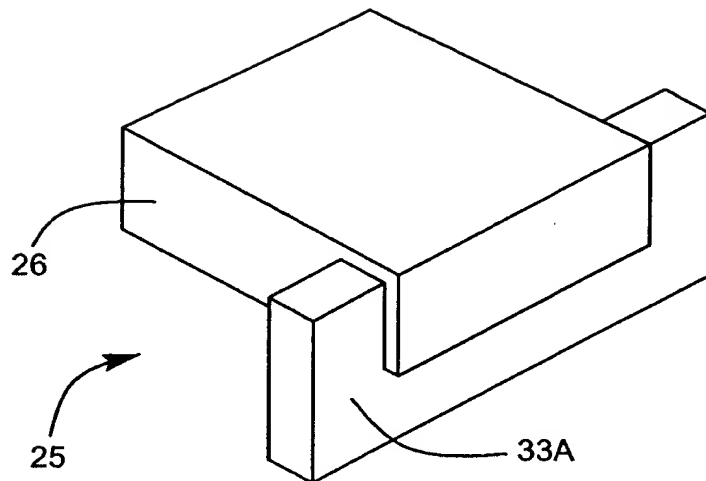


FIG. 1G6

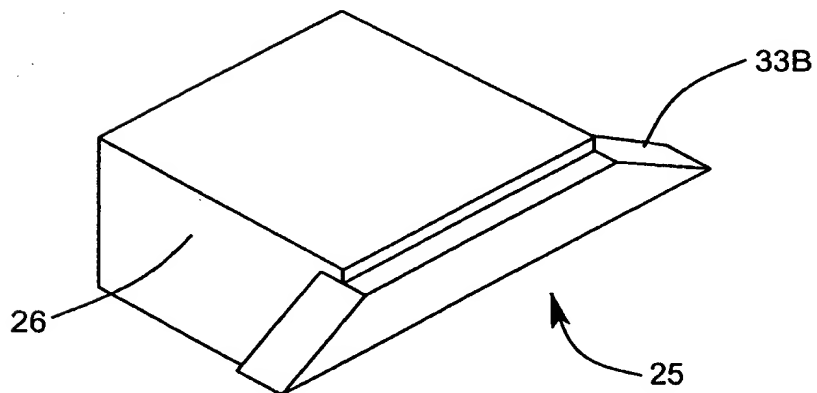
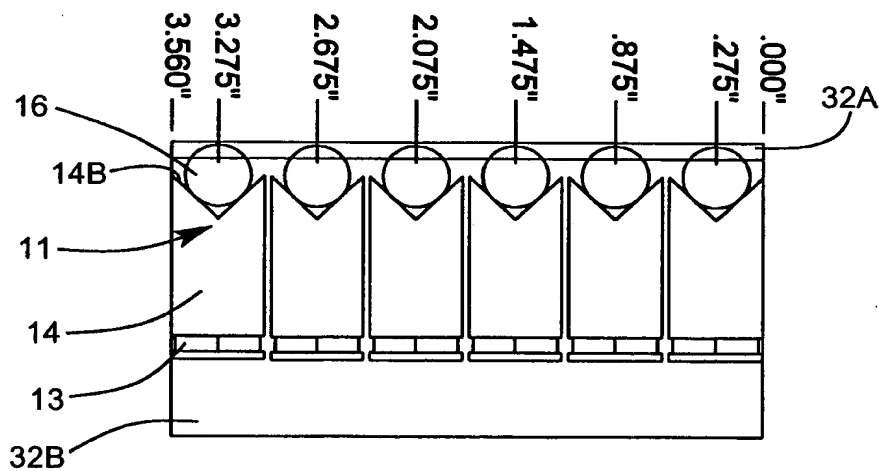
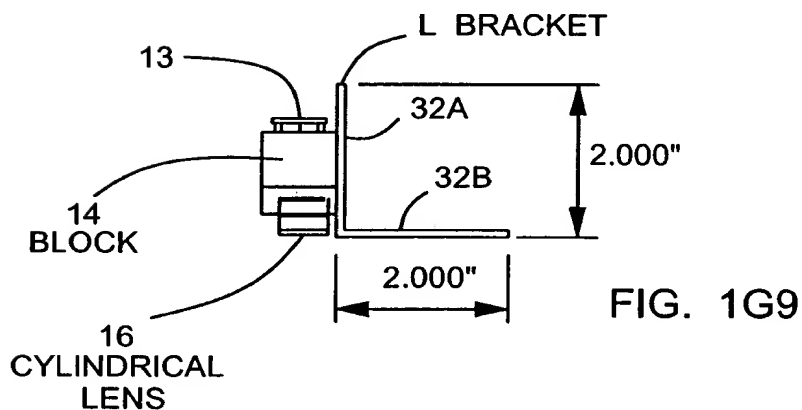
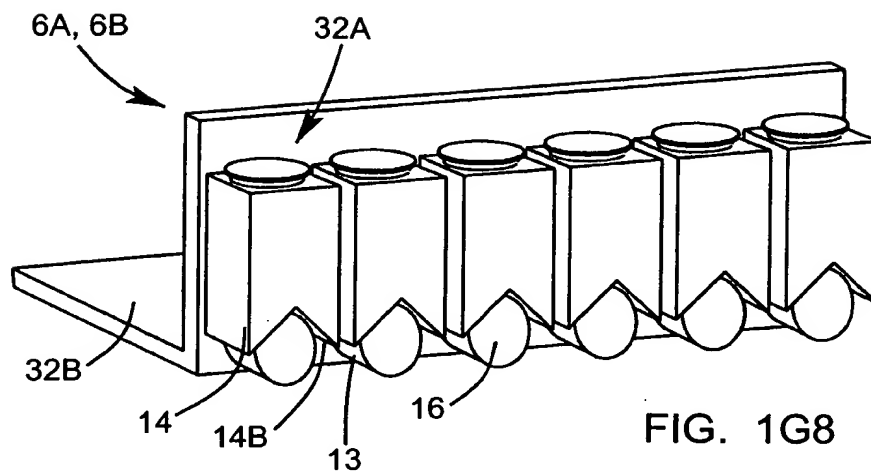


FIG. 1G7



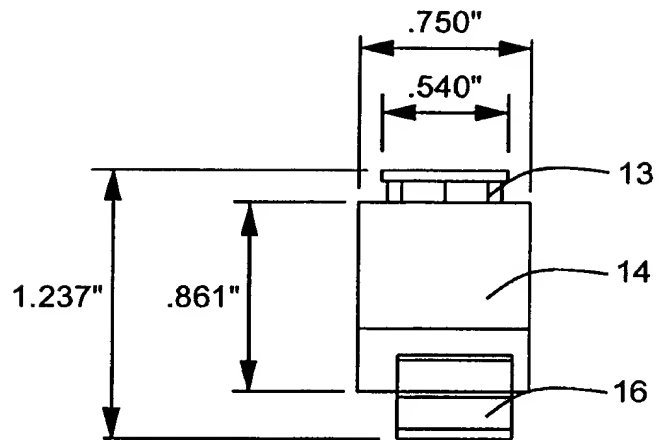


FIG. 1G11

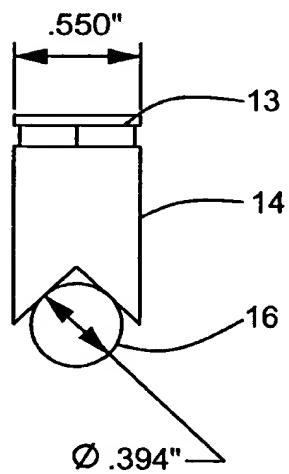
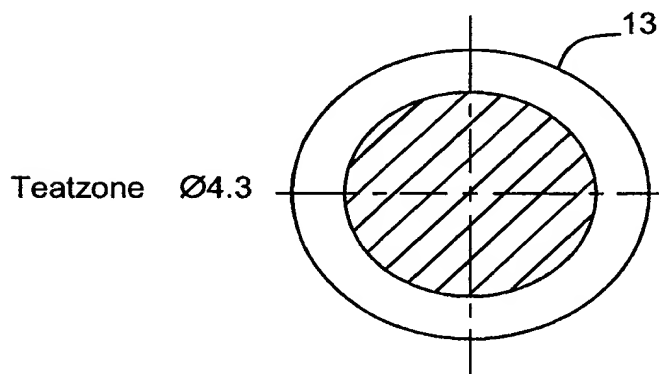
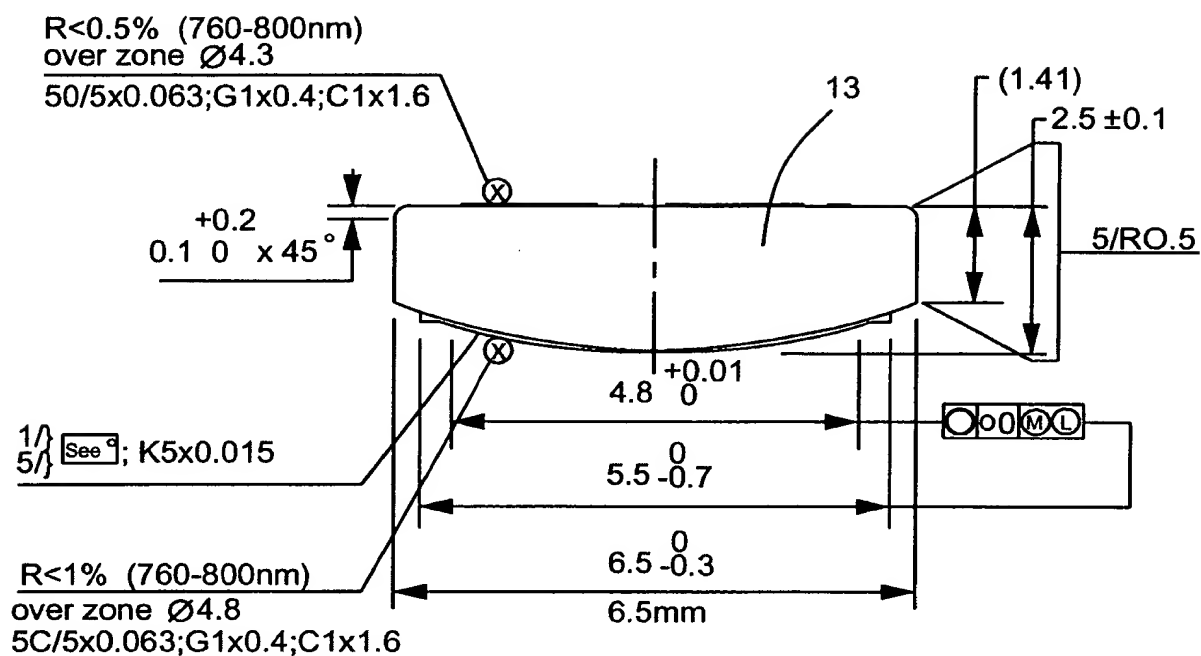


FIG. 1G12



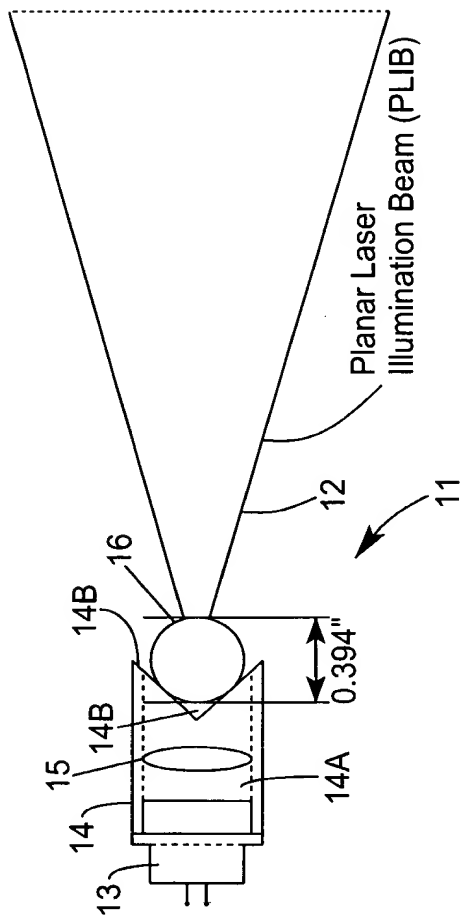


FIG. 1G15A

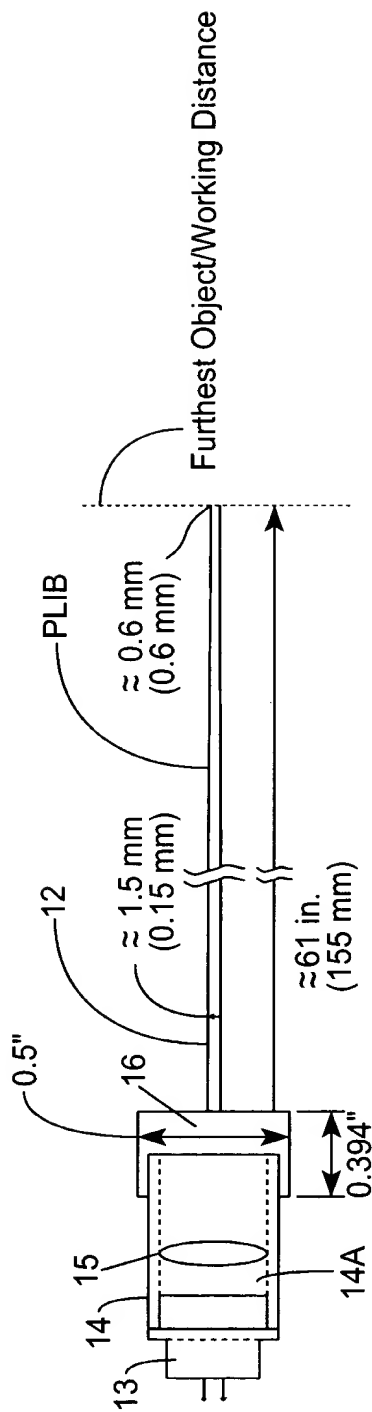


FIG. 1G15B

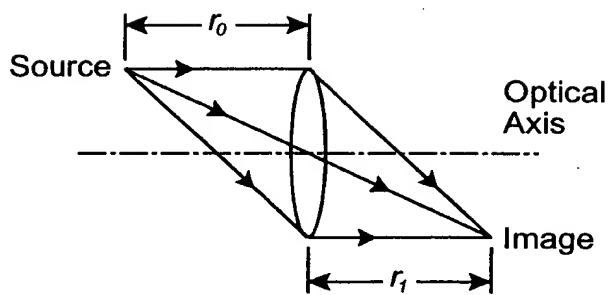


FIG. 1H1

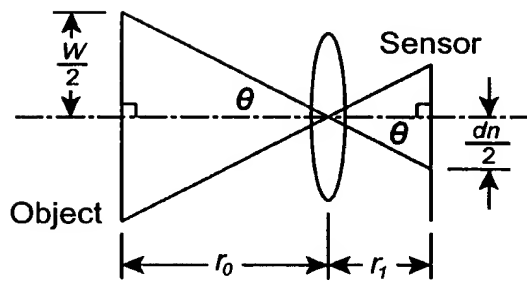


FIG. 1H2

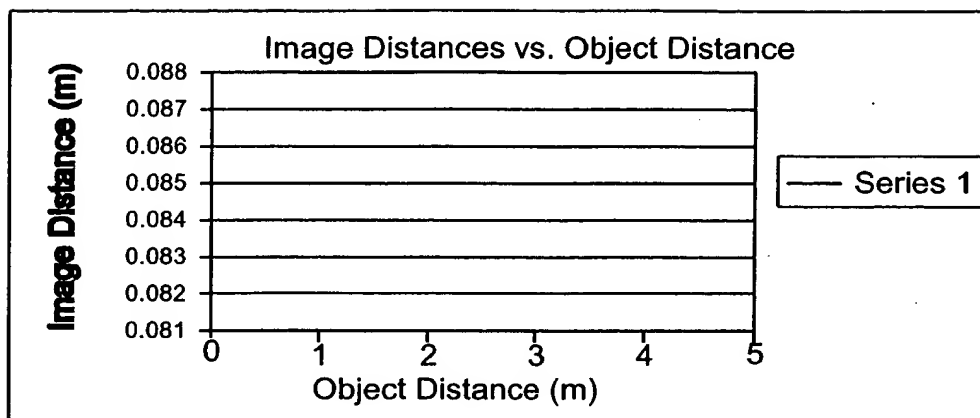


FIG. 1H3

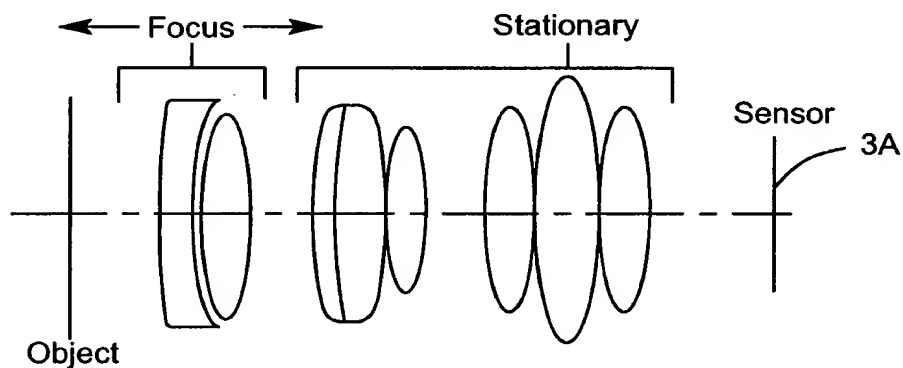


FIG. 1H4

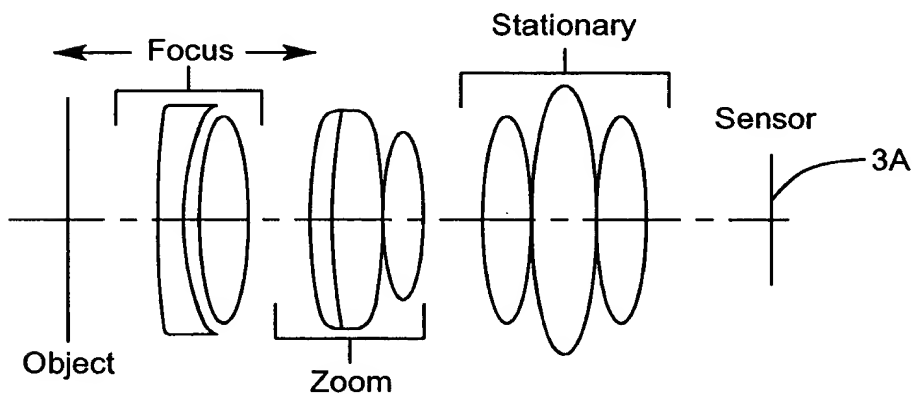


FIG. 1H5

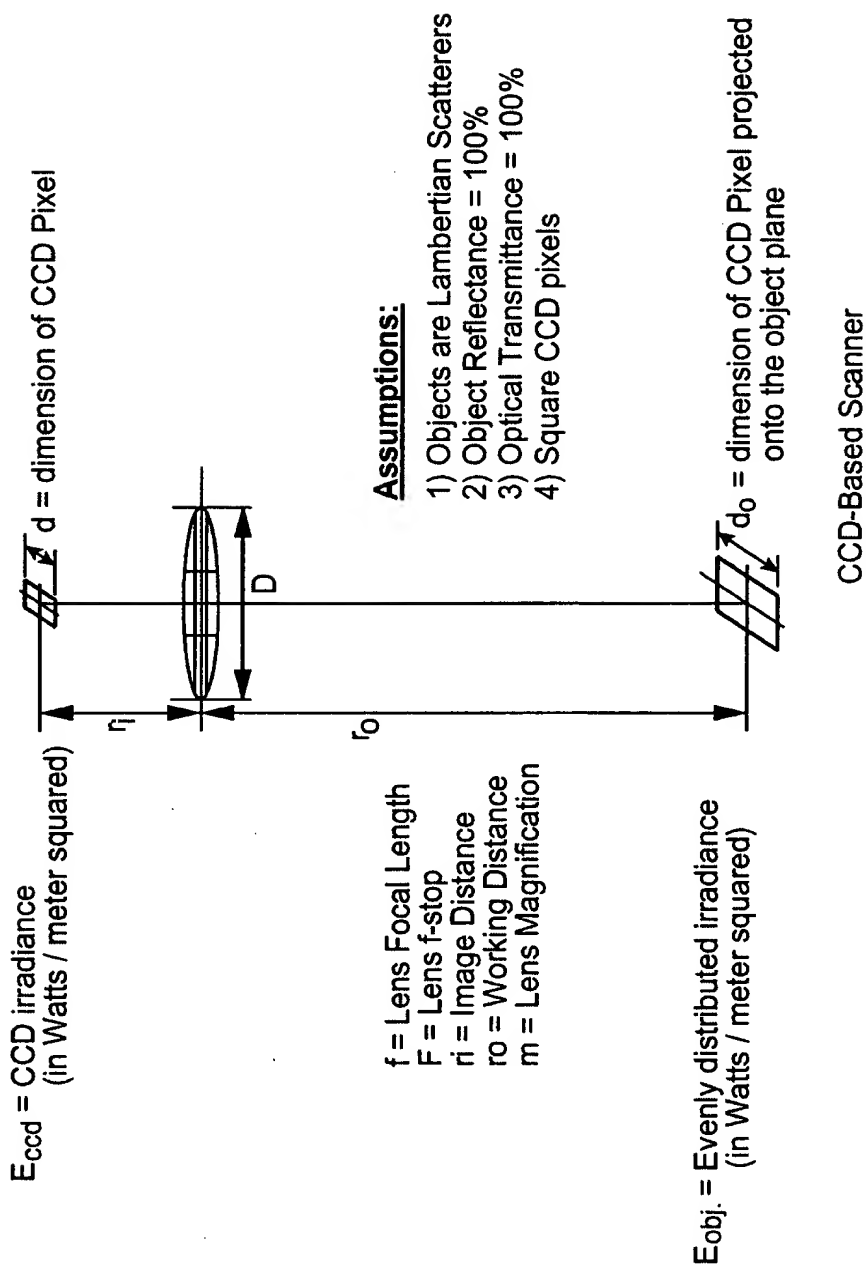


FIG. 1H6

FIRST GENERALIZED METHOD OF REDUCING
SPECKLE-NOISE PATTERNS AT IMAGE DETECTION
ARRAY OF THE IFD SUBSYSTEM (3)

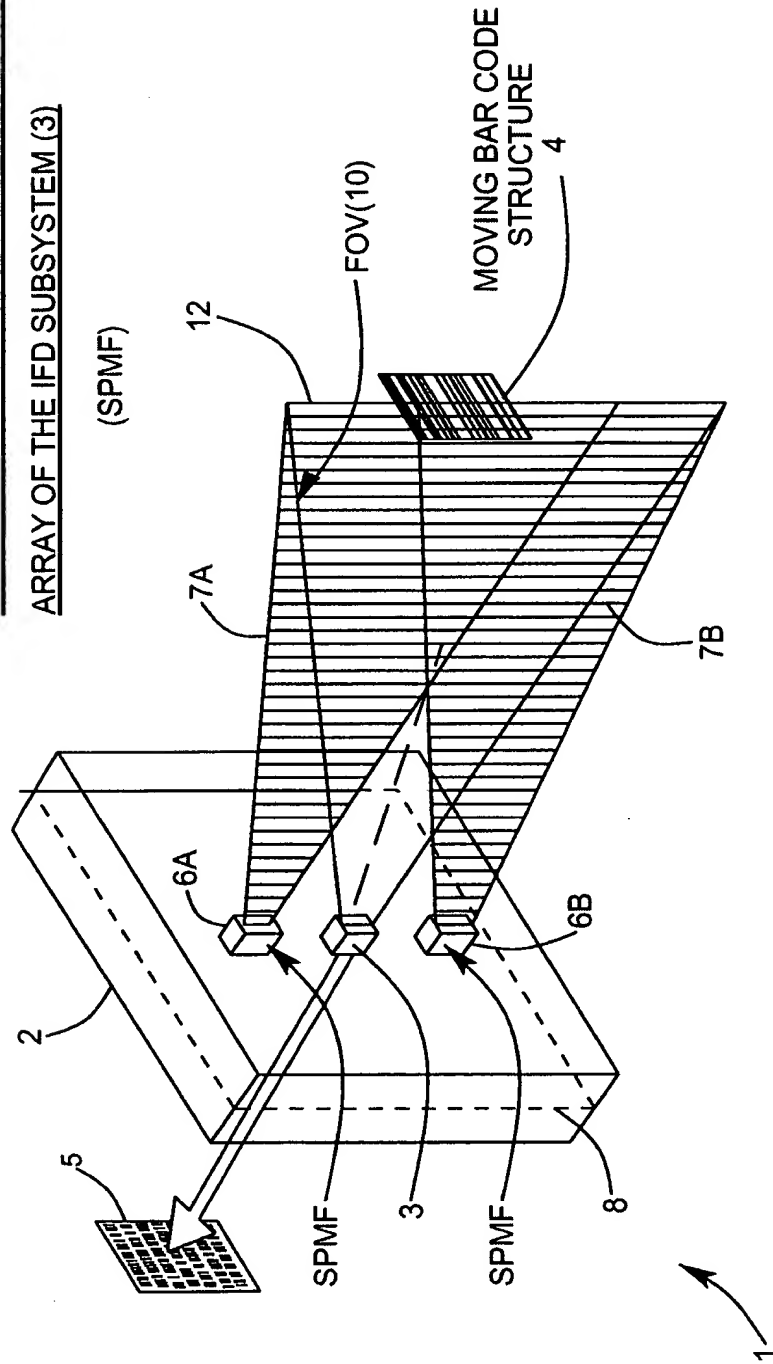


FIG. 111

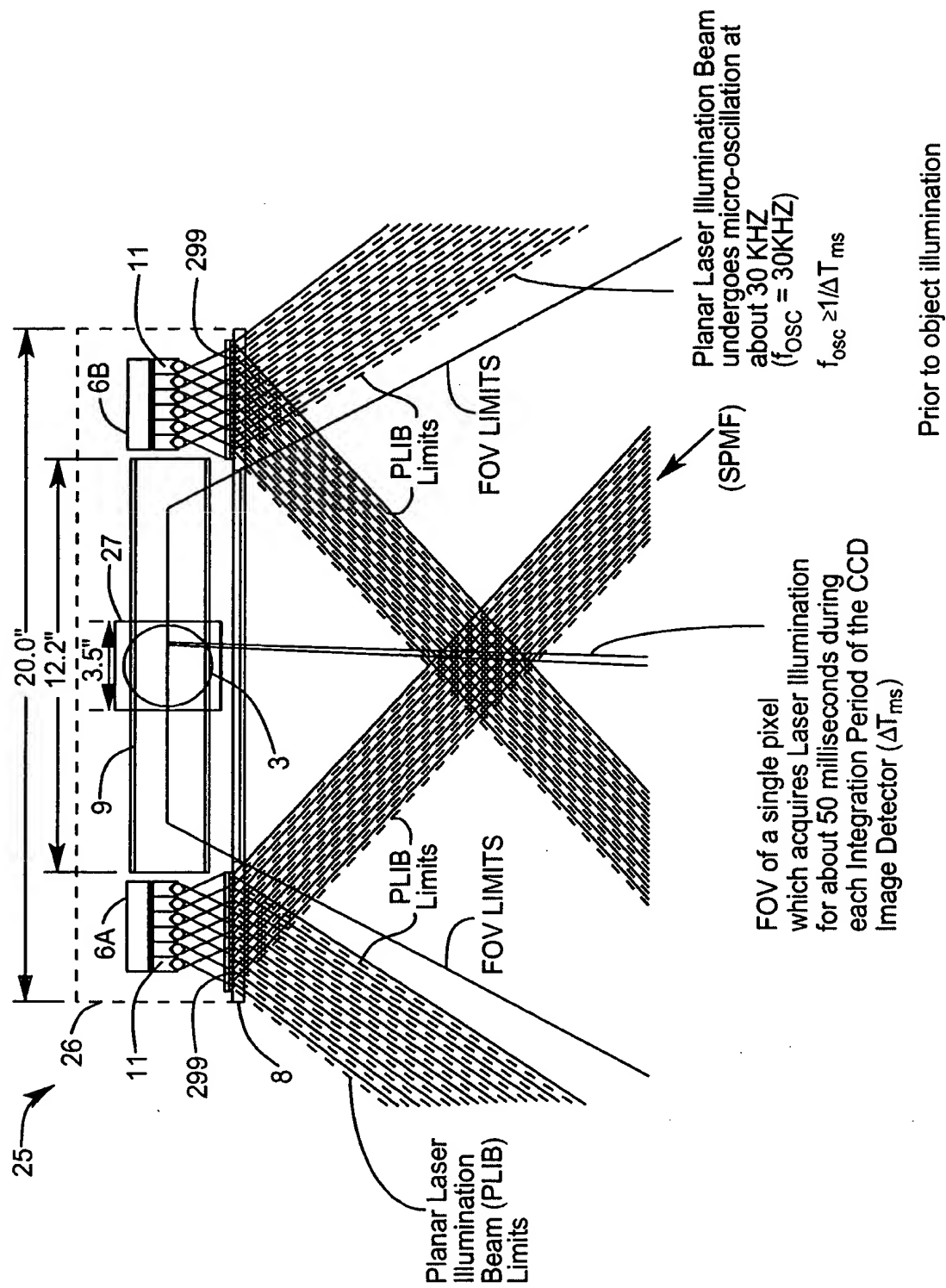


FIG. 112A



THE FIRST GENERALIZED SPECKLE-NOISE PATTERN REDUCTION
METHOD OF THE PRESENT INVENTION

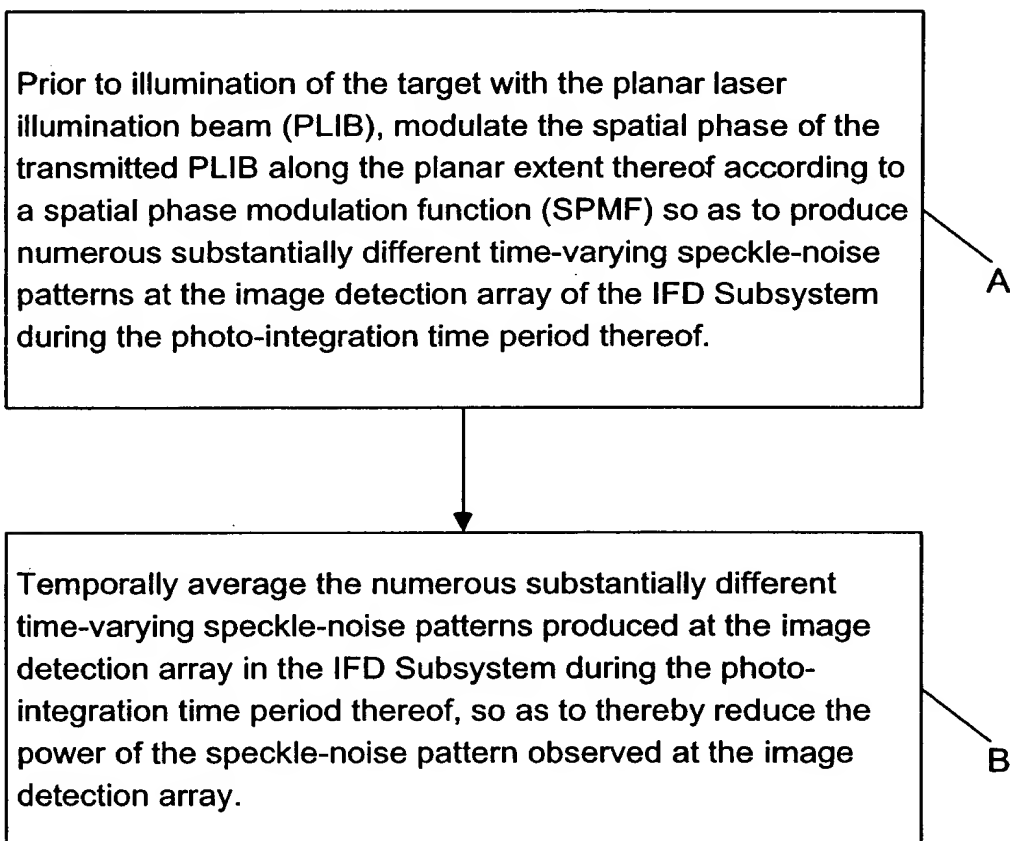


FIG. 112B

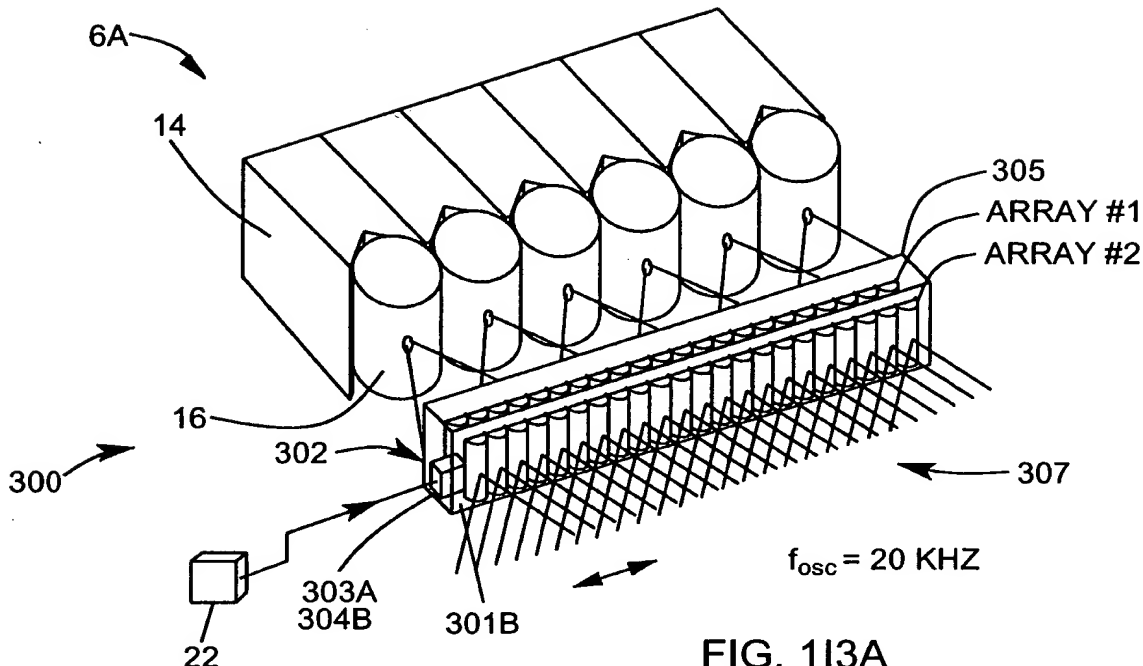


FIG. 113A

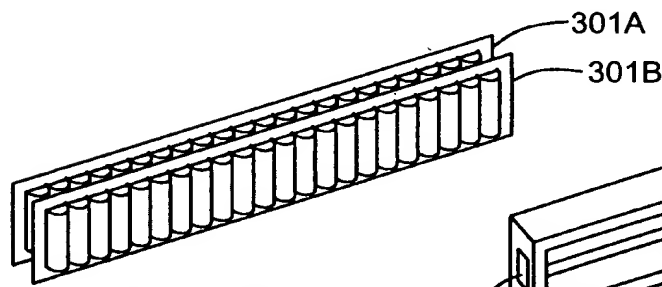


FIG. 113B

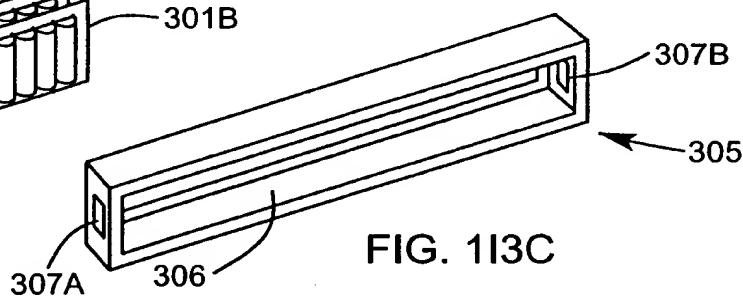


FIG. 113C

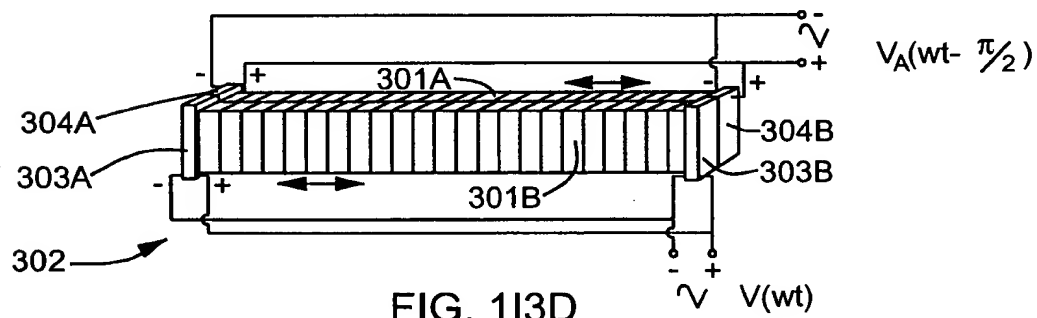
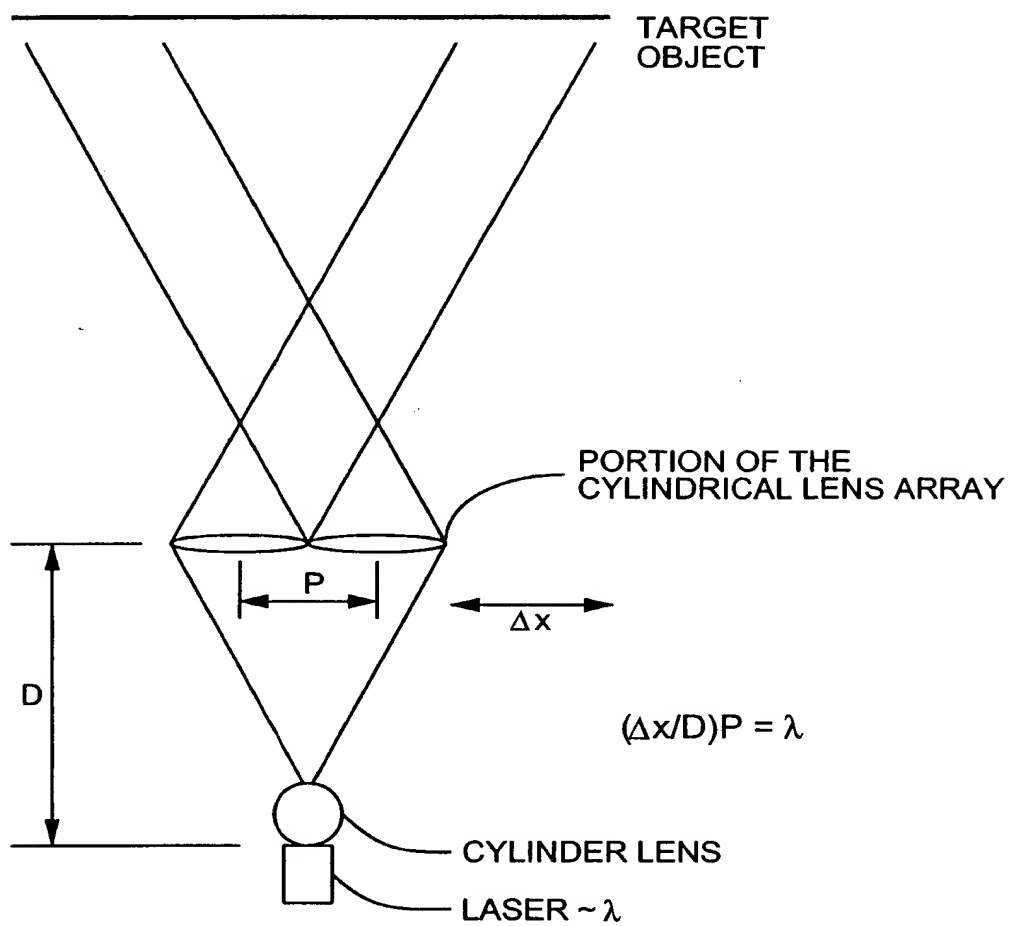


FIG. 113D



$$\Delta x \geq \frac{\lambda \cdot D}{P}$$

FIG. 113E

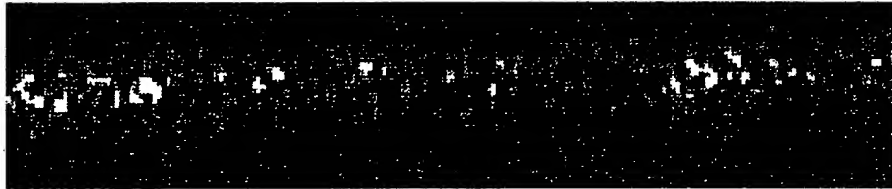


FIG. 113F

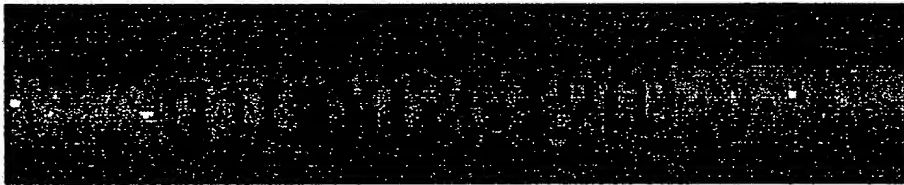
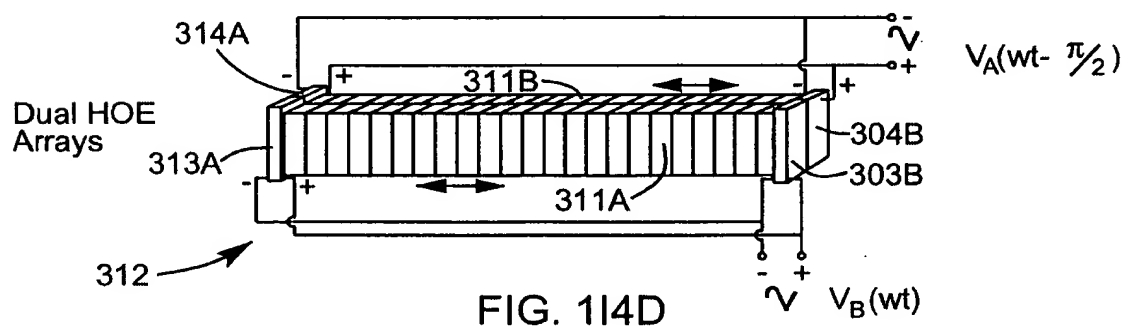
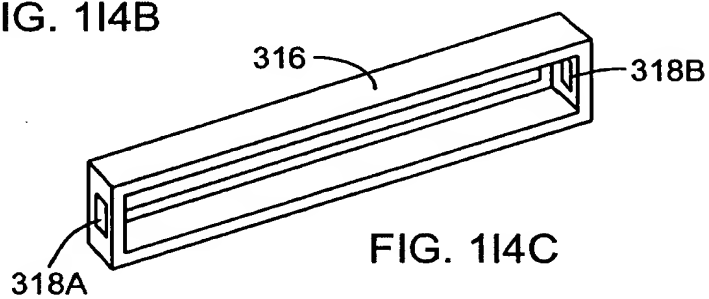
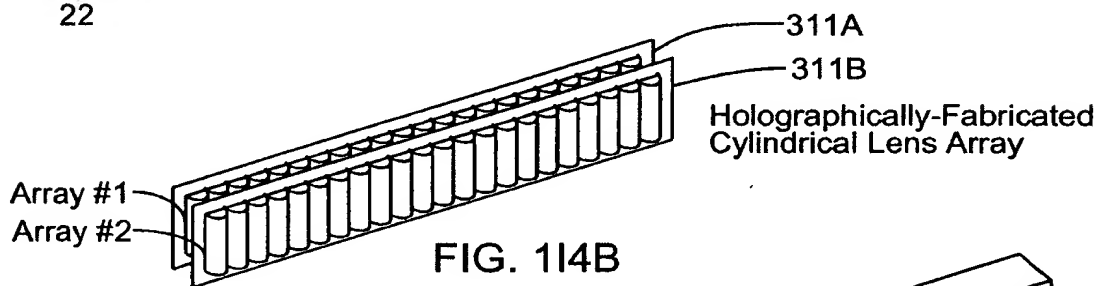
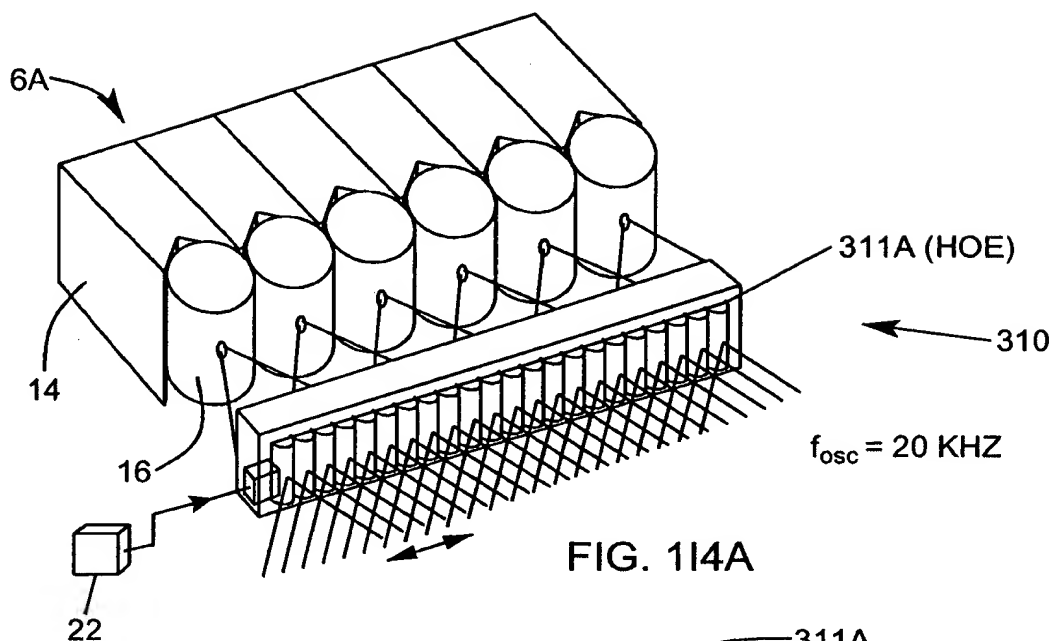
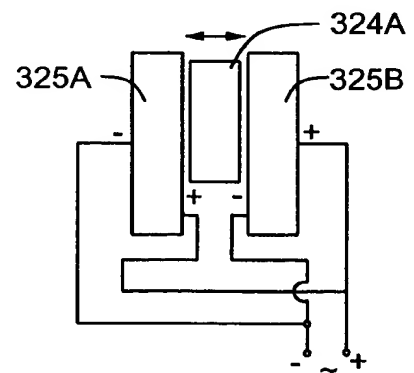
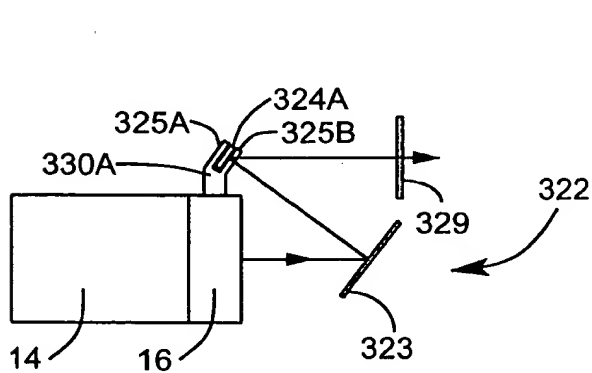
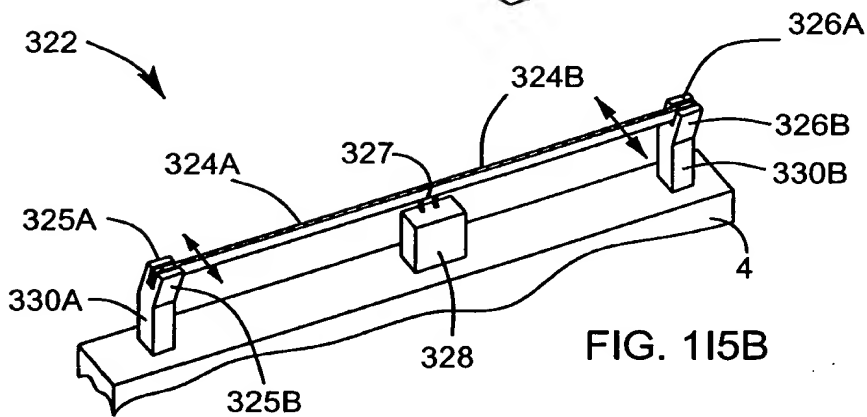
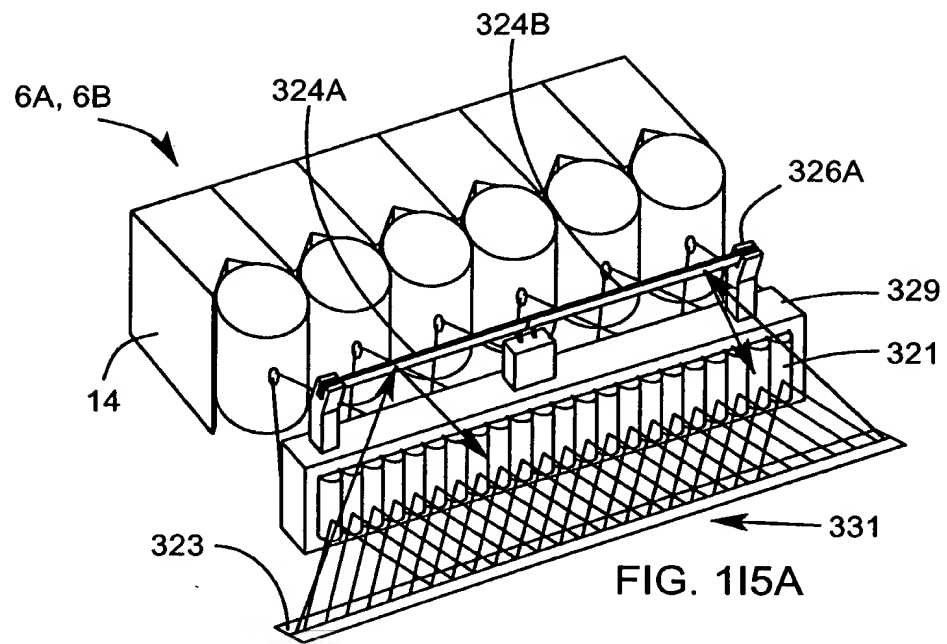


FIG. 113G





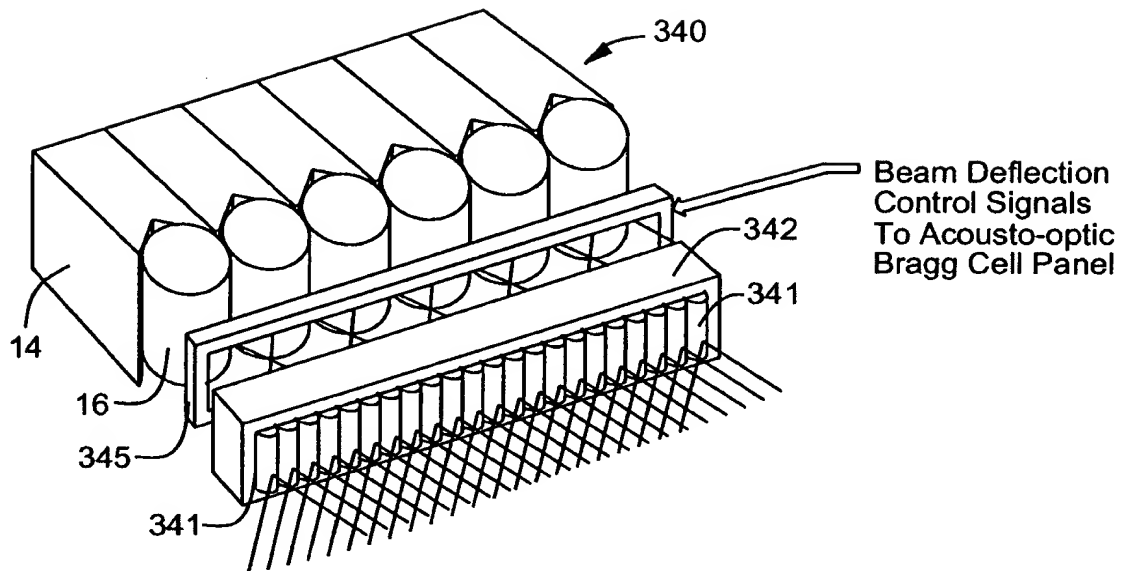


FIG. 116A

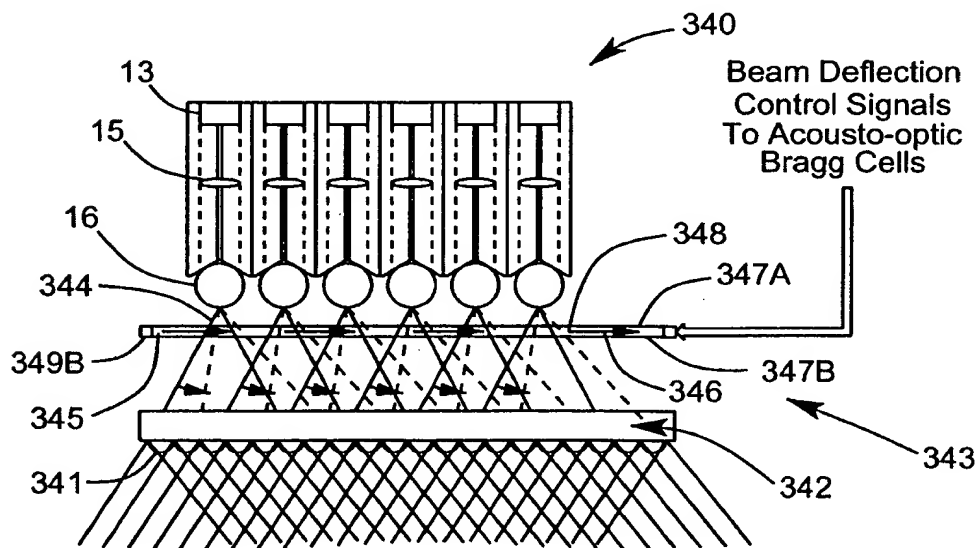


FIG. 116B

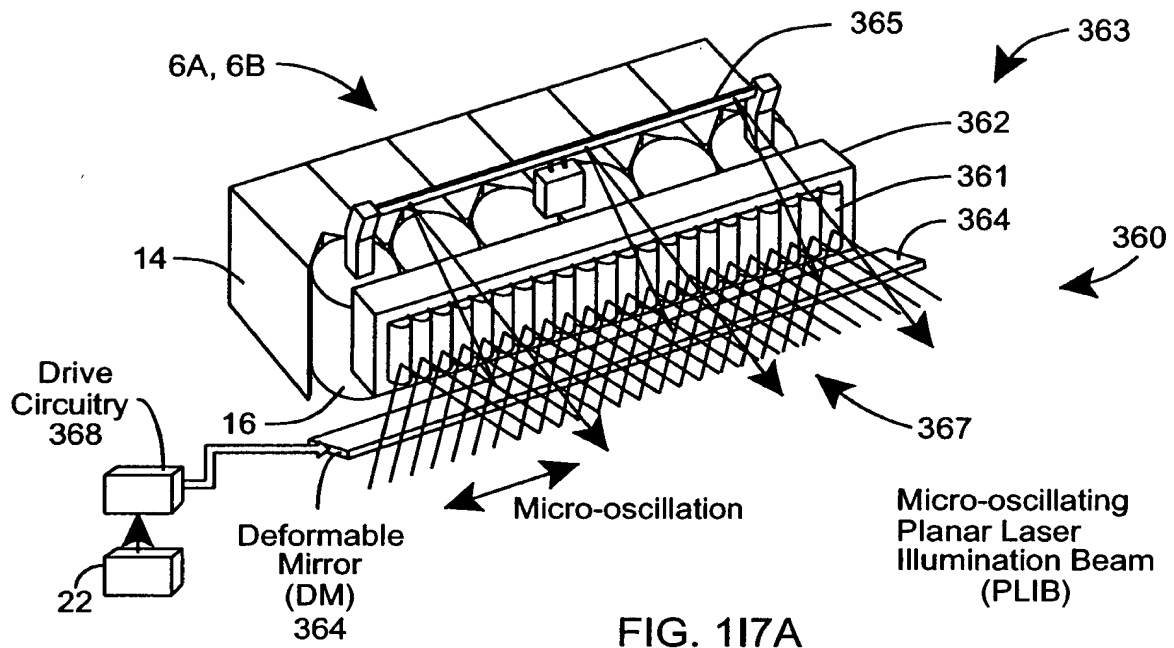


FIG. 117A

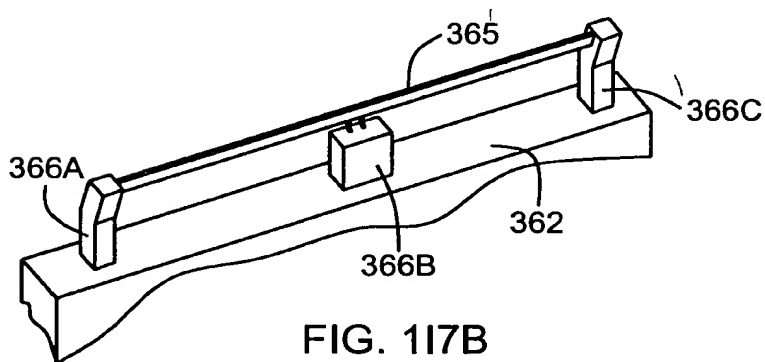


FIG. 117B

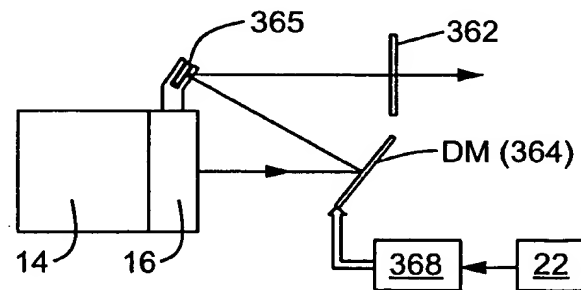


FIG. 117C

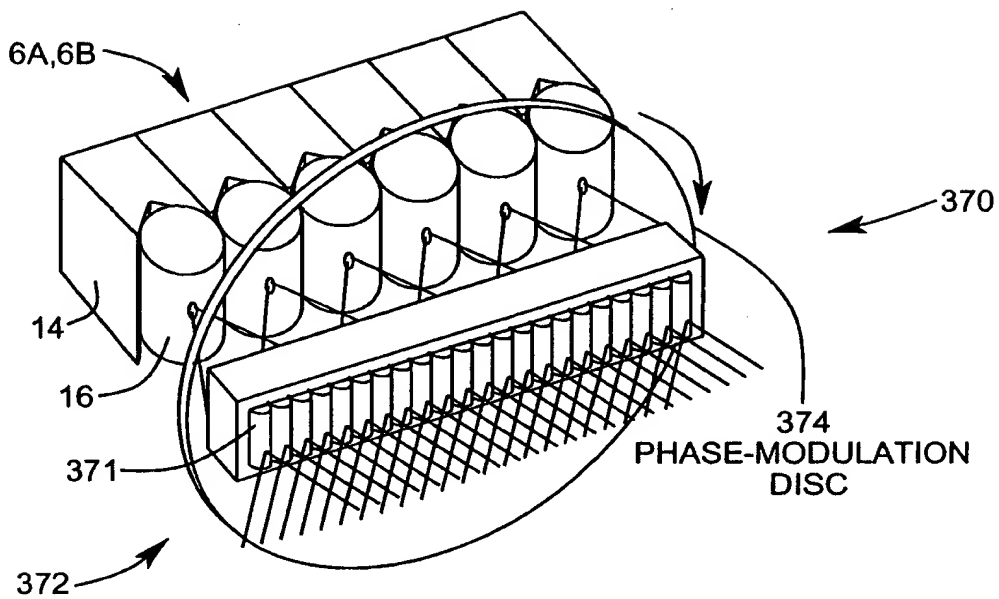


FIG. 118A

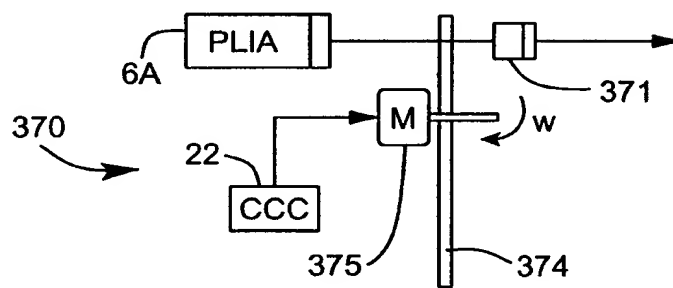


FIG. 118B

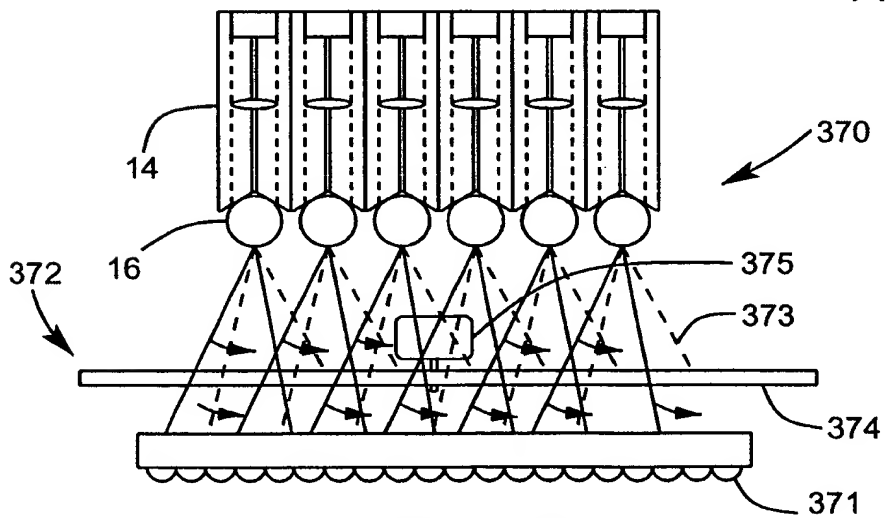


FIG. 118C

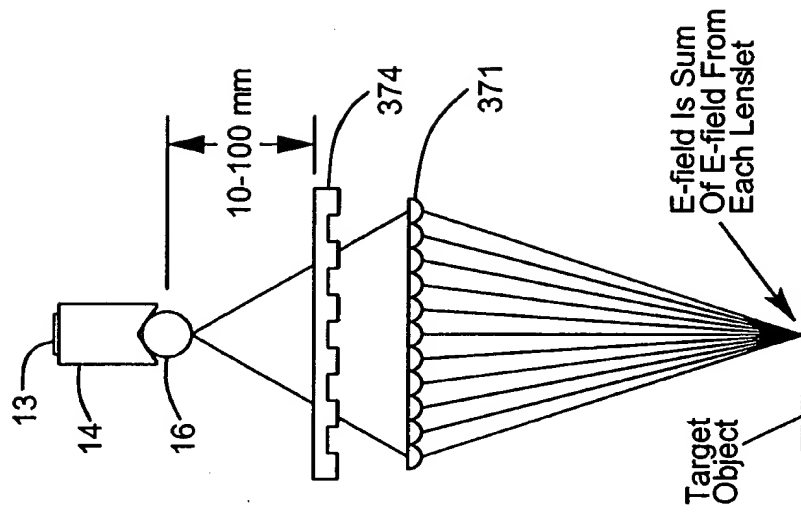


FIG. 118E

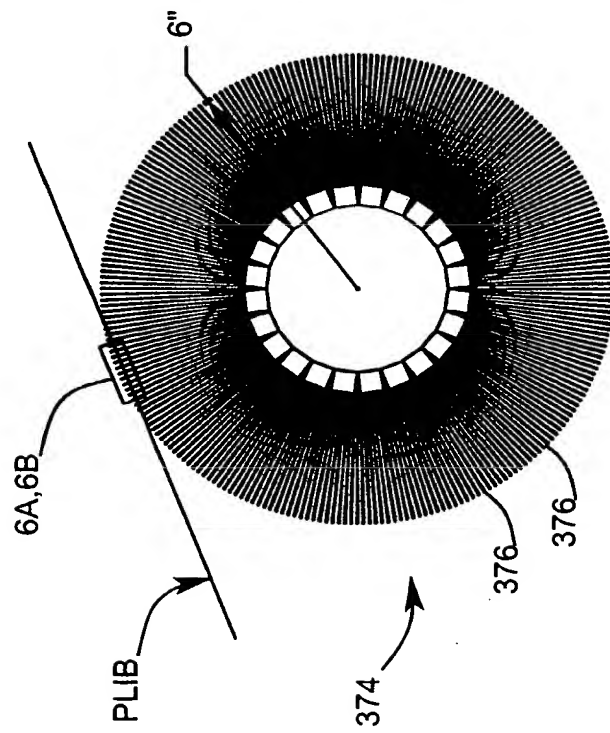
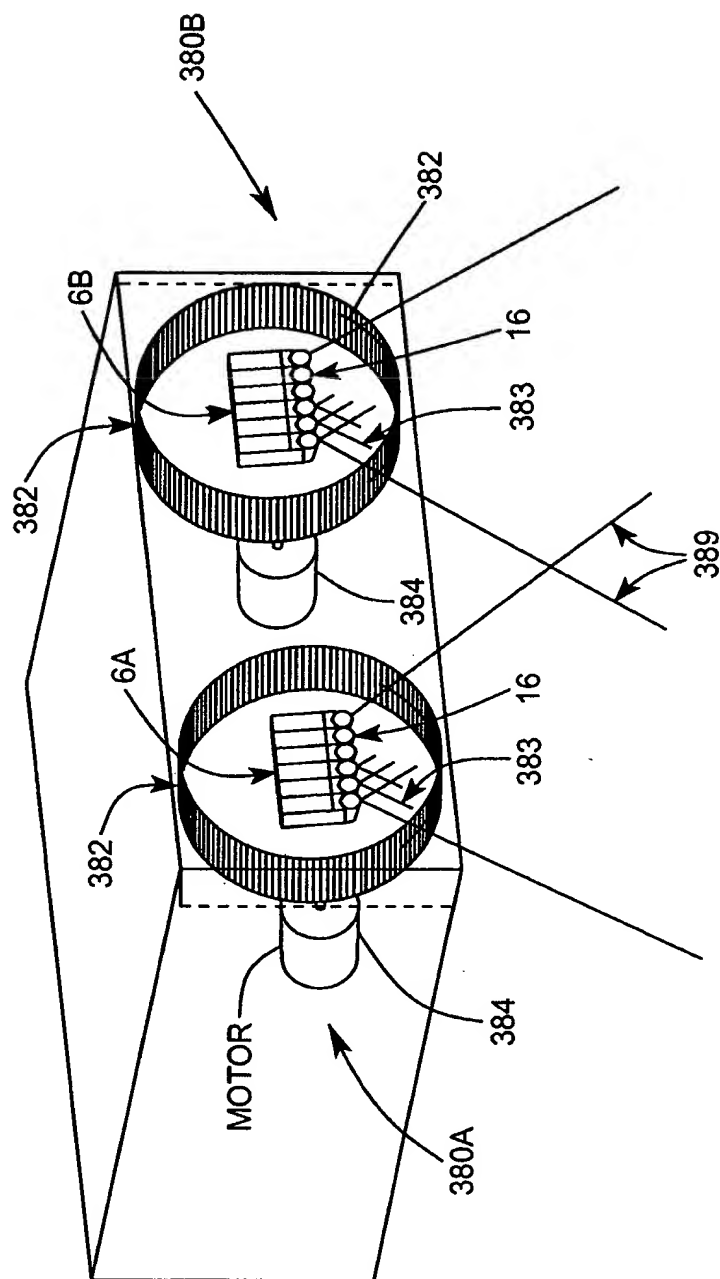
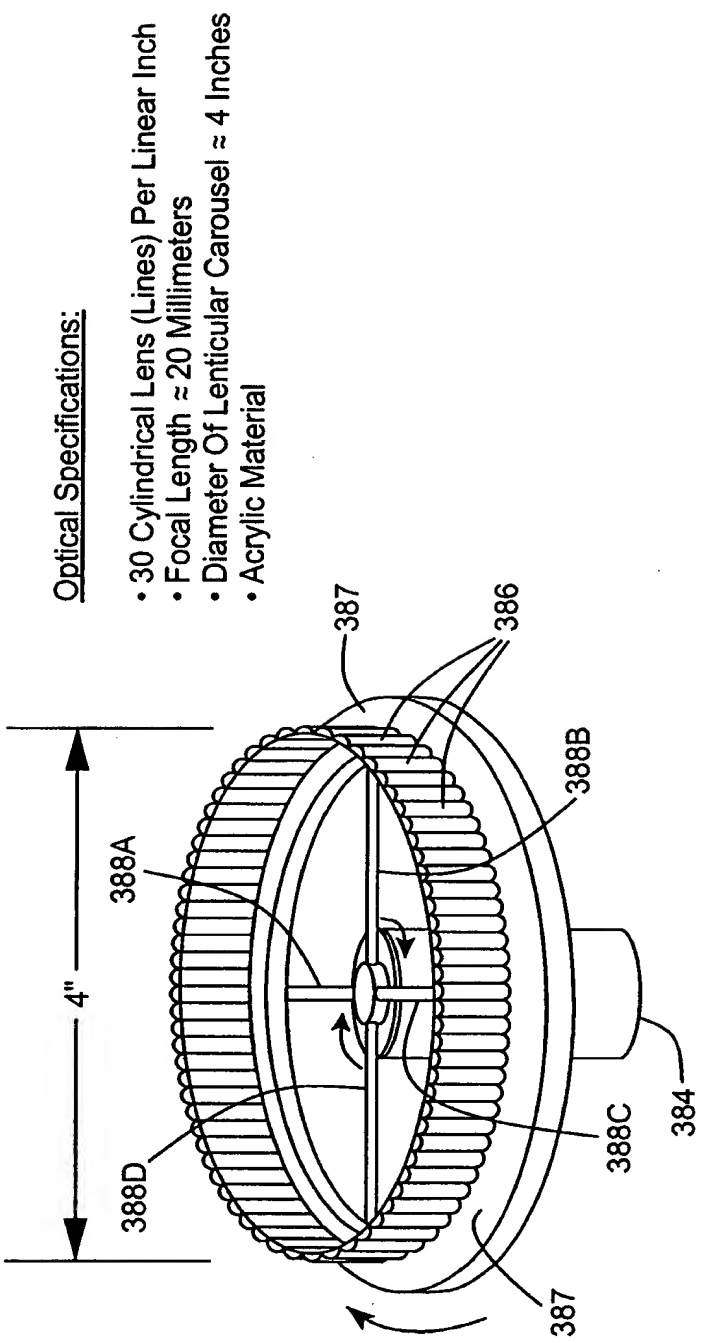


FIG. 118D





Optical Specifications:

- 30 Cylindrical Lens (Lines) Per Linear Inch
- Focal Length \approx 20 Millimeters
- Diameter Of Lenticular Carousel \approx 4 Inches
- Acrylic Material

FIG. 119B

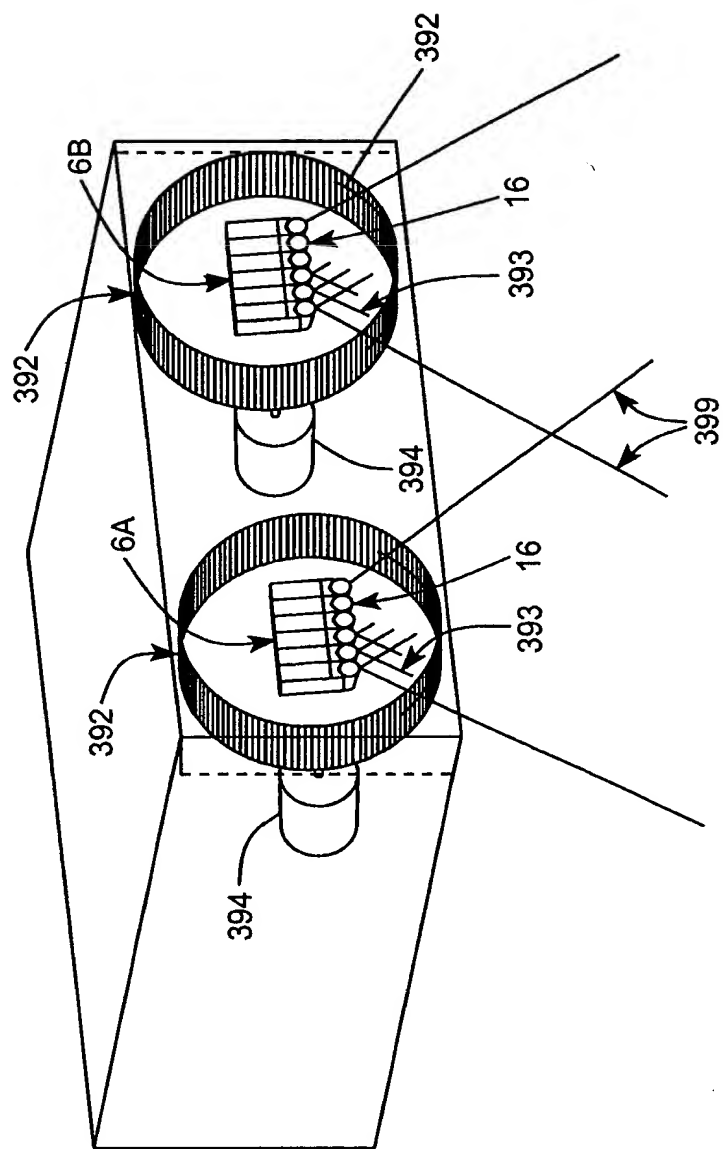


FIG. 1110A

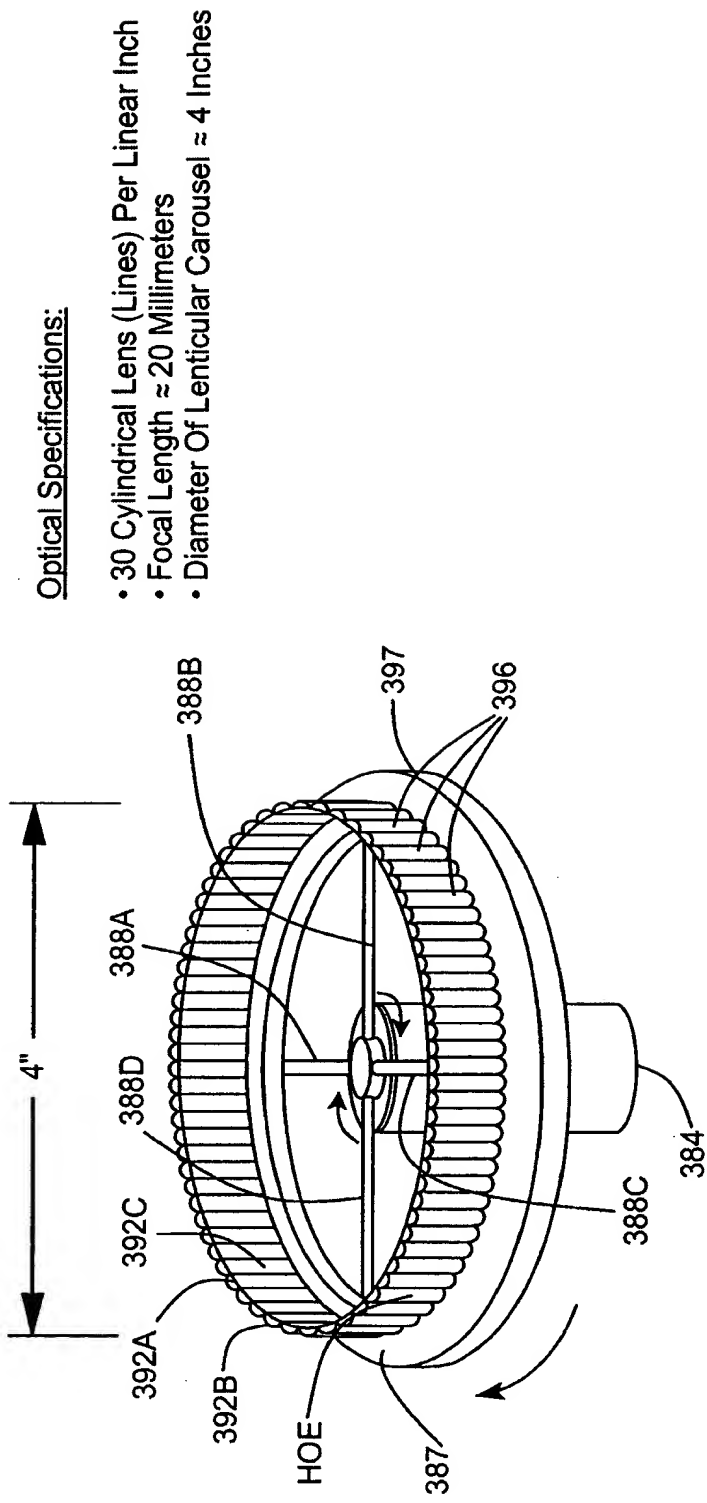
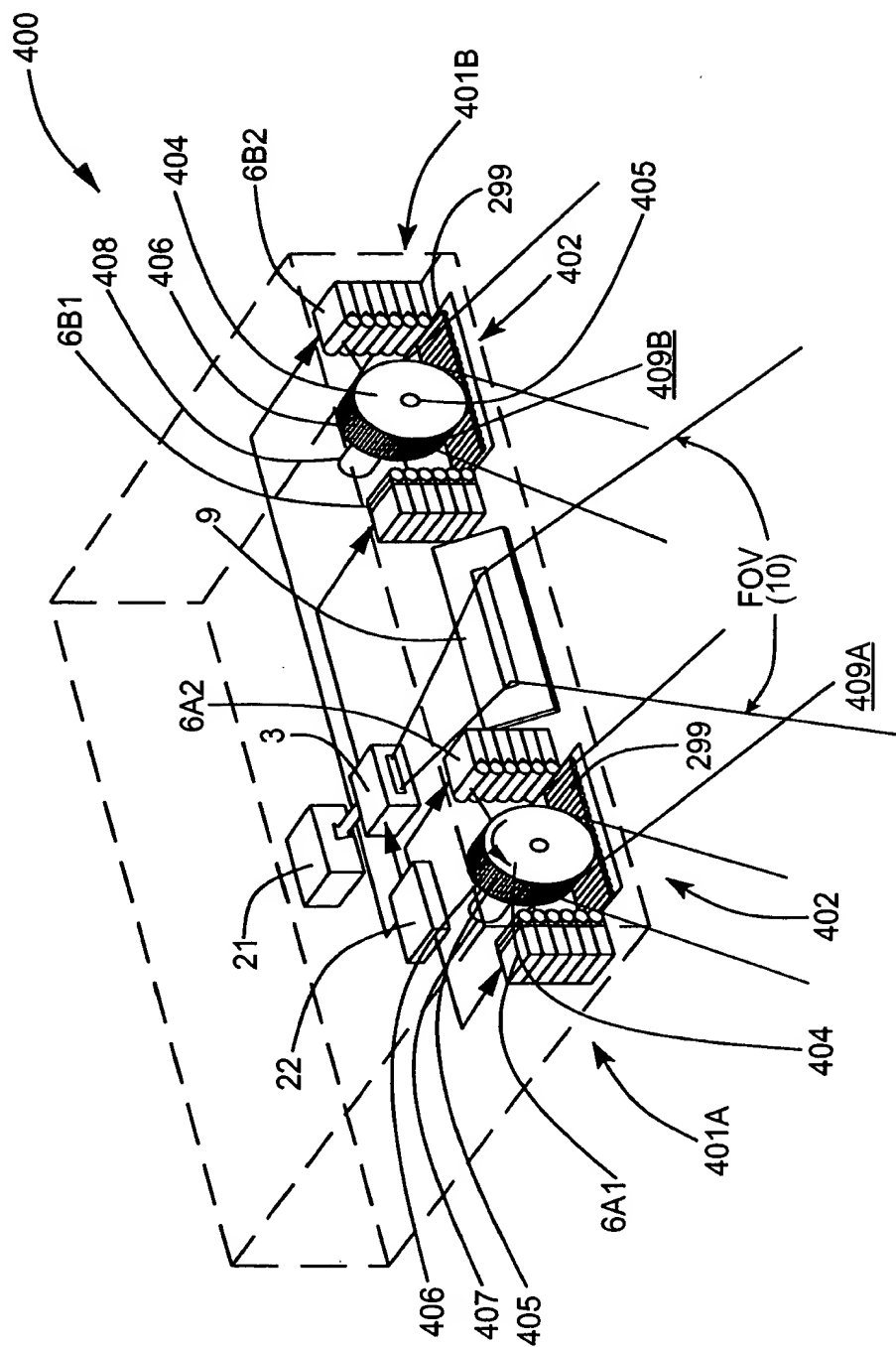


FIG. 1110B



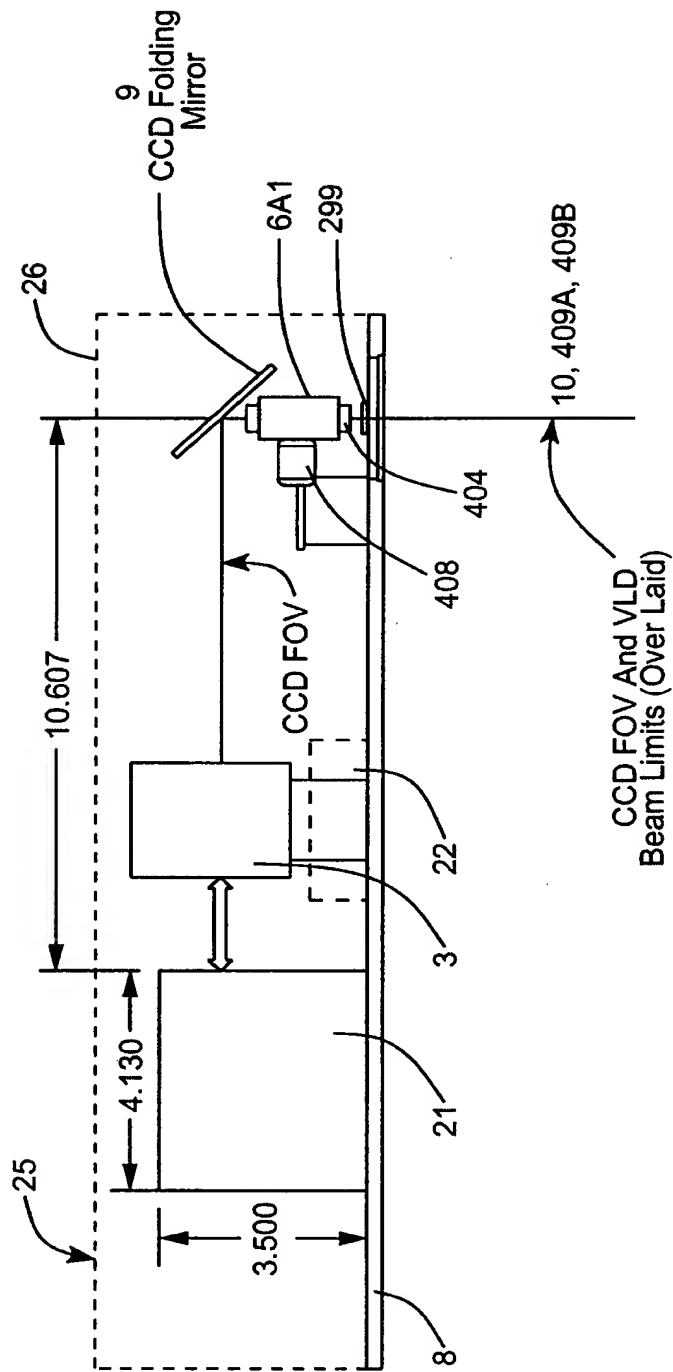


FIG. 1111B

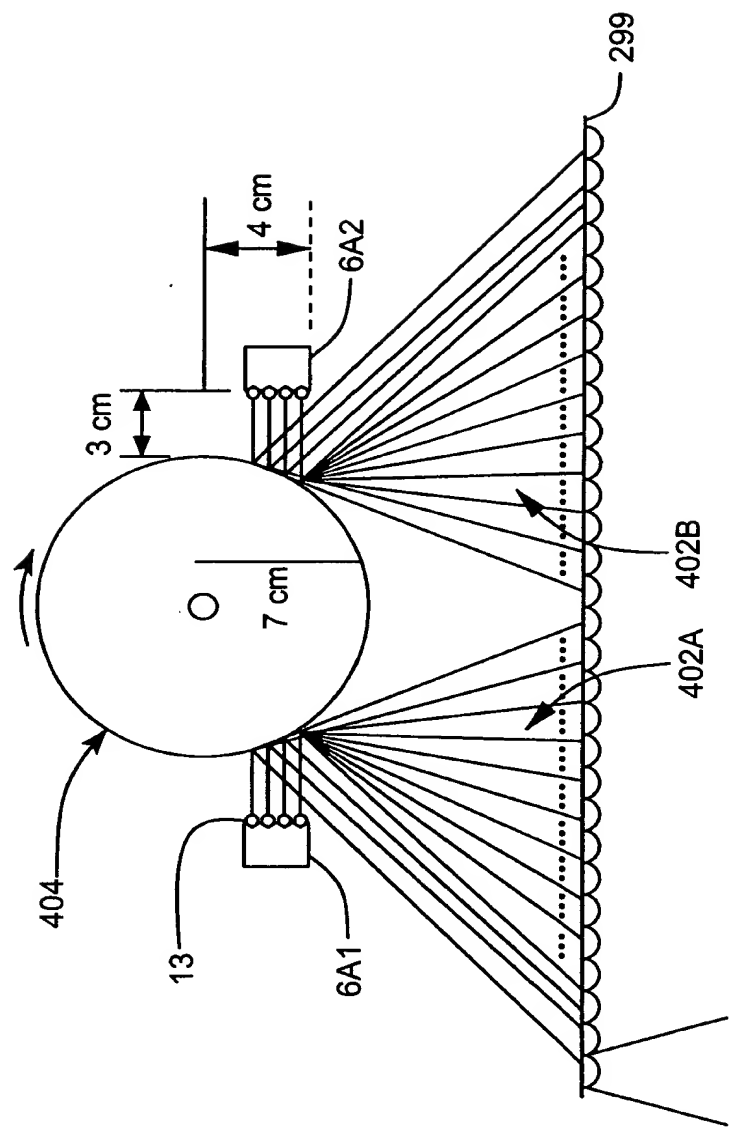


FIG. 1111C

Second Generalized Method Of
Reducing Speckle-Noise Patterns
At Image Detection Array
Of The IFD Subsystem (3)

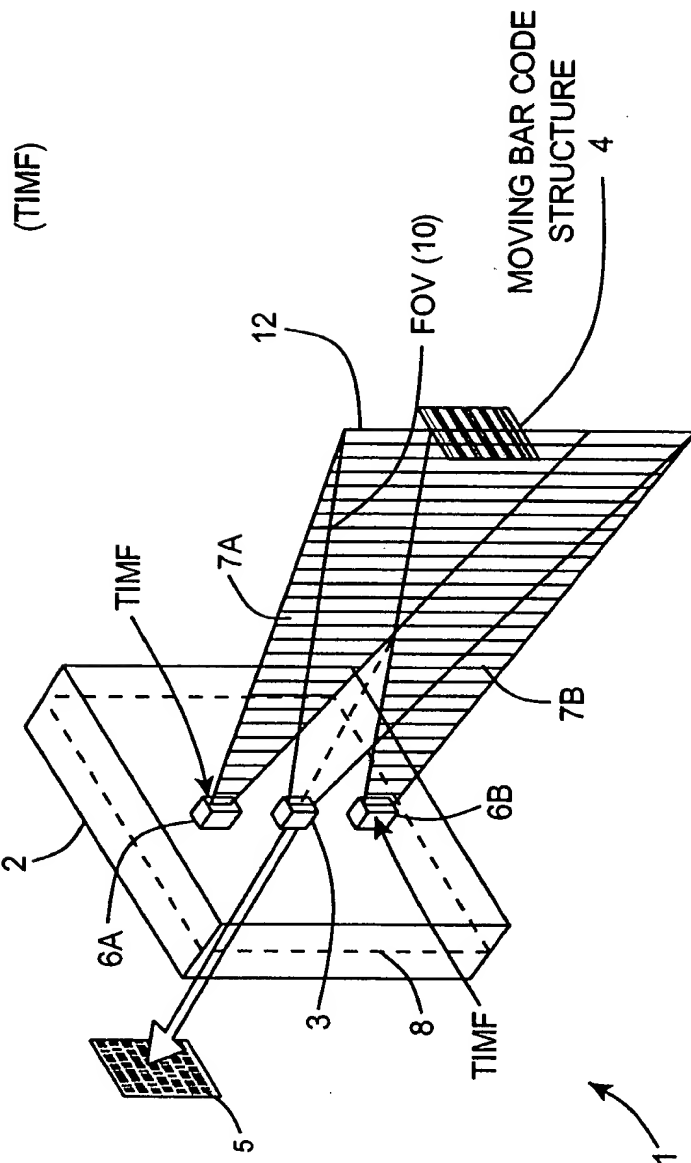


FIG. 1112

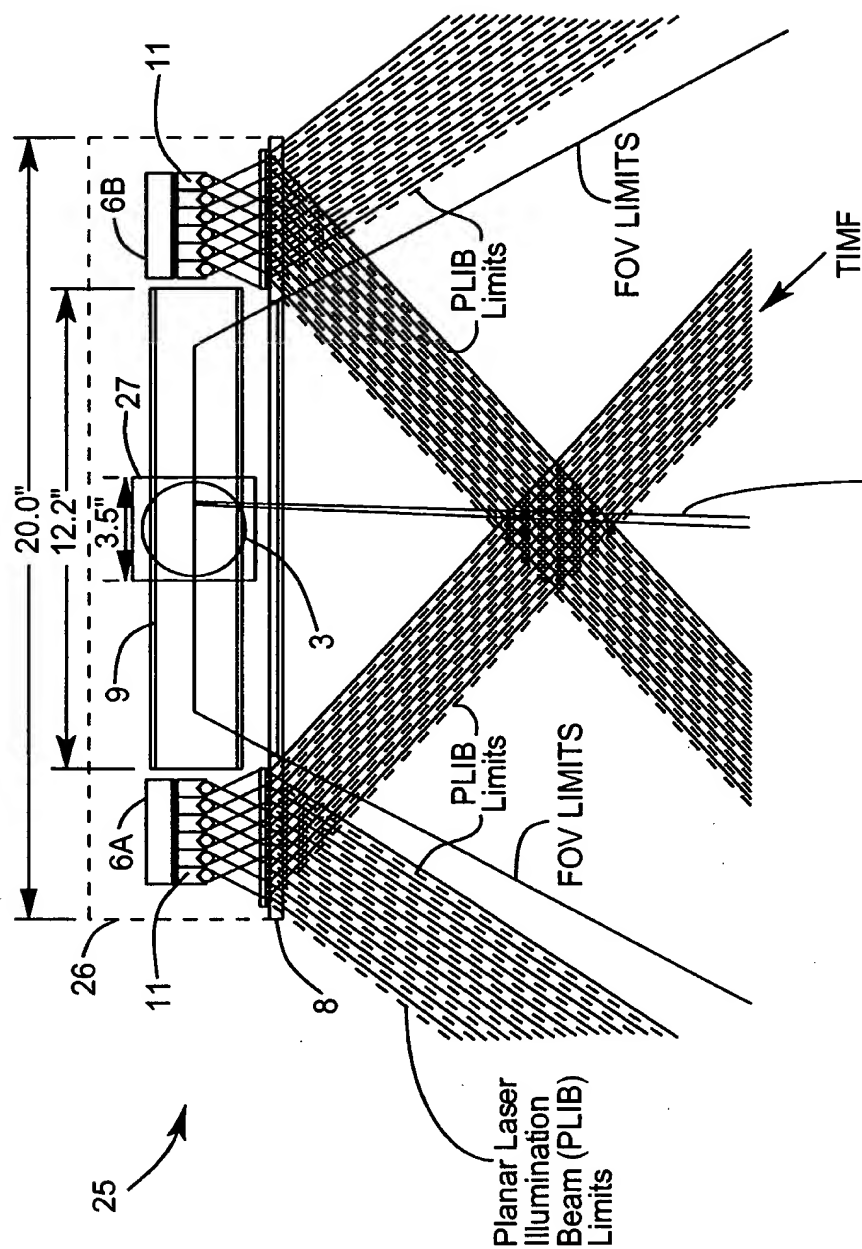


FIG. 1113A



THE SECOND GENERALIZED SPECKLE-NOISE PATTERN REDUCTION
METHOD OF THE PRESENT INVENTION

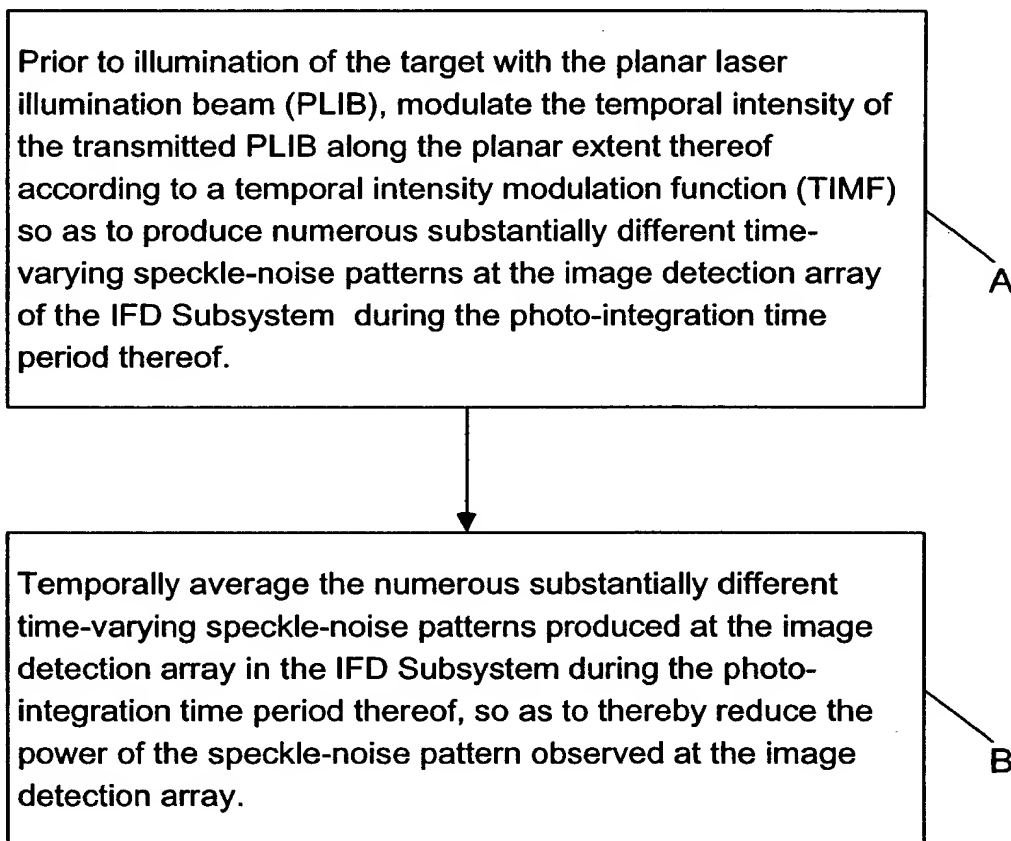


FIG. 1113B

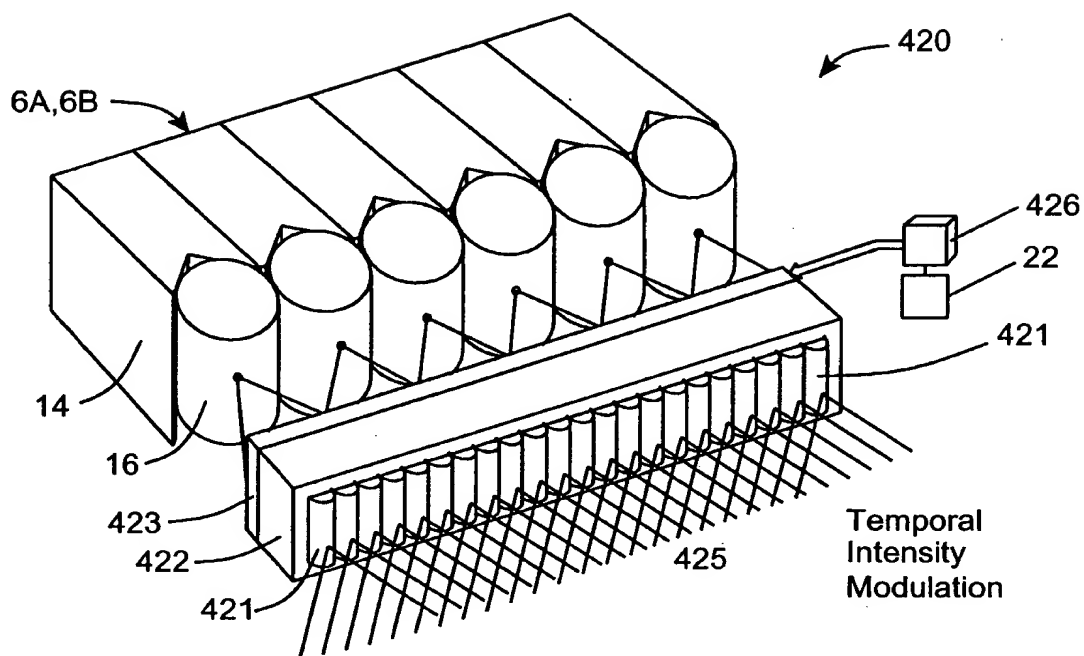


FIG. 114A

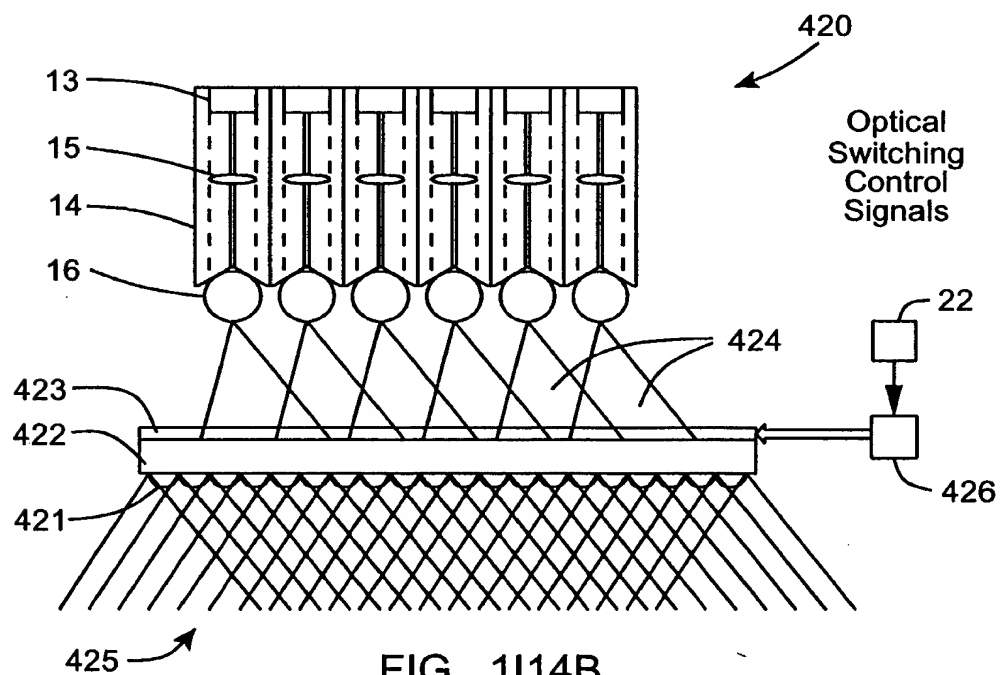


FIG. 1114B

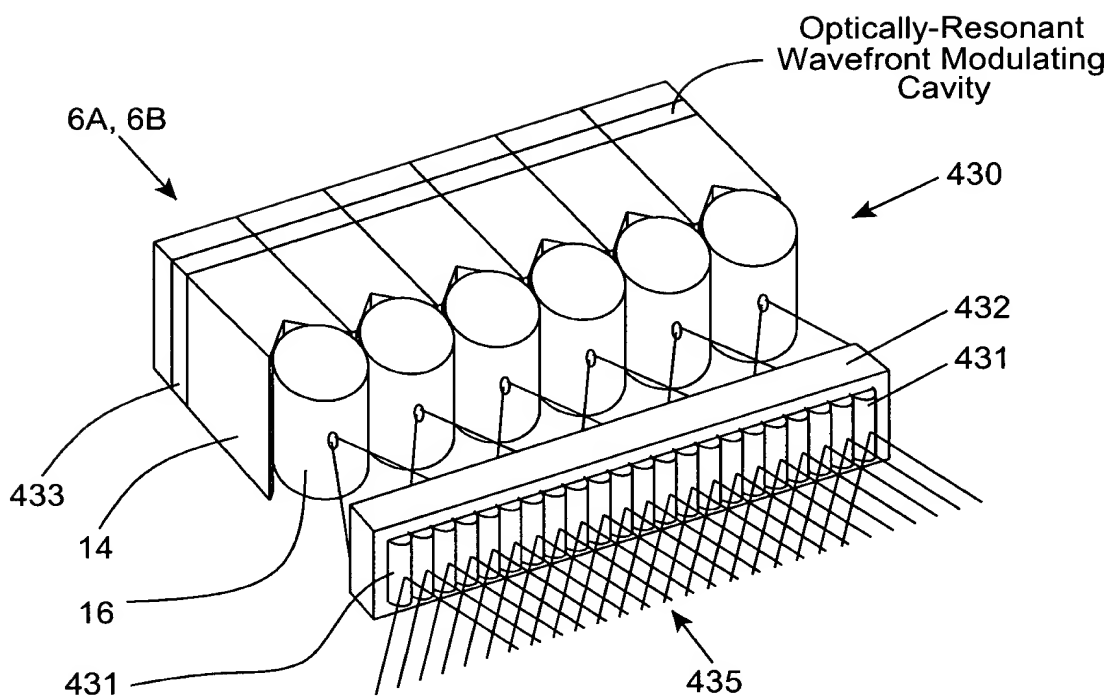


FIG. 1115A

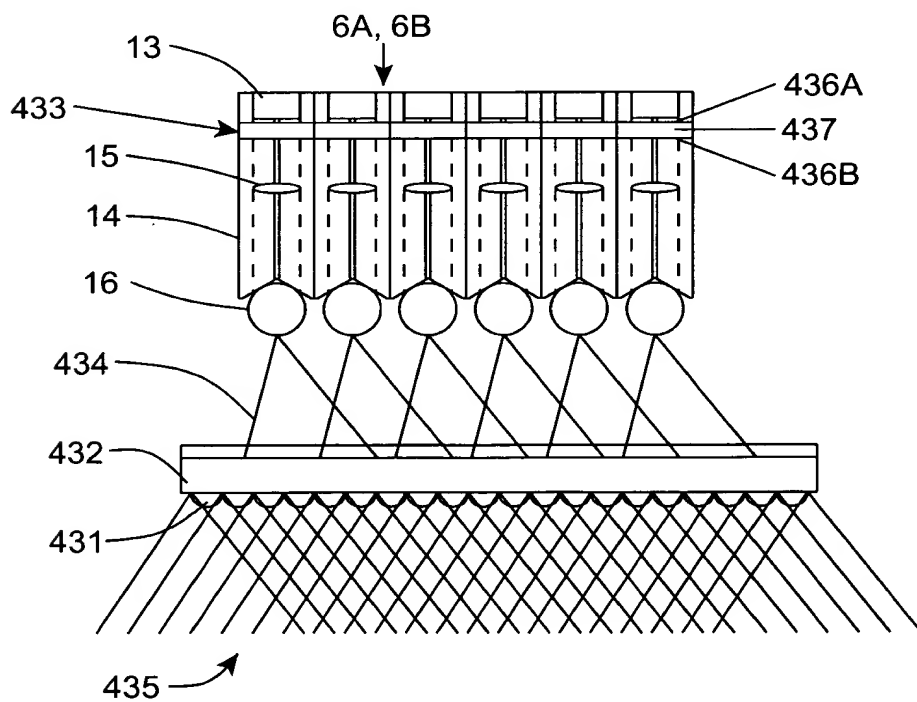


FIG. 1115B

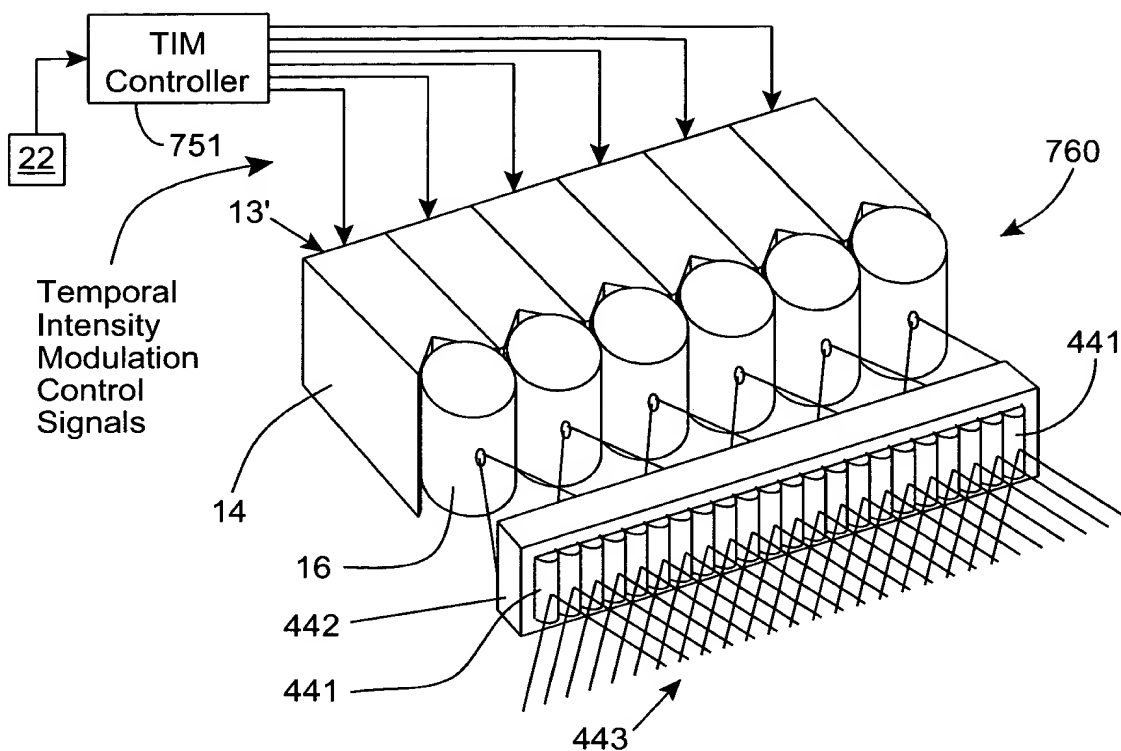


FIG. 1I15C

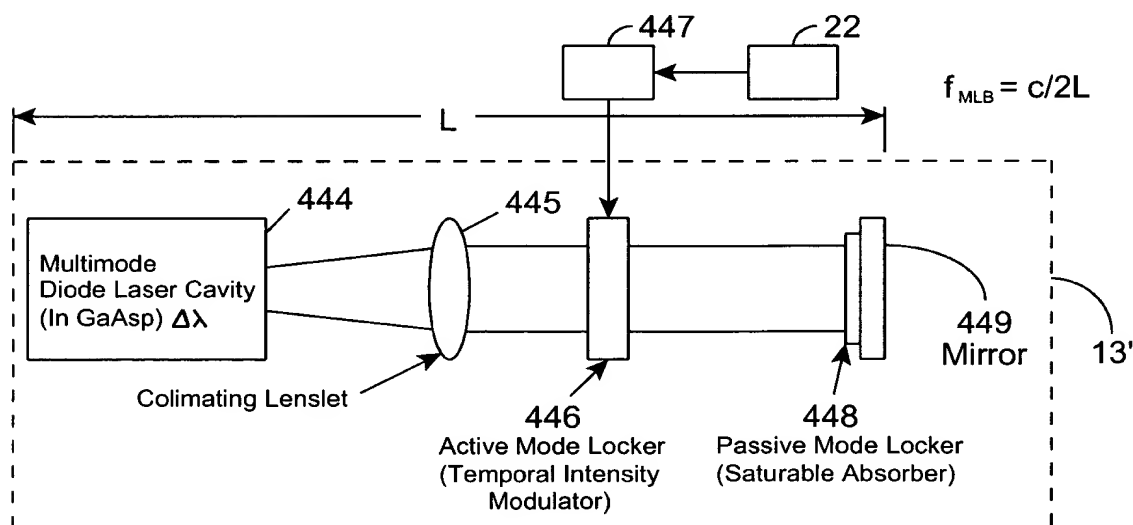


FIG. 1I15D

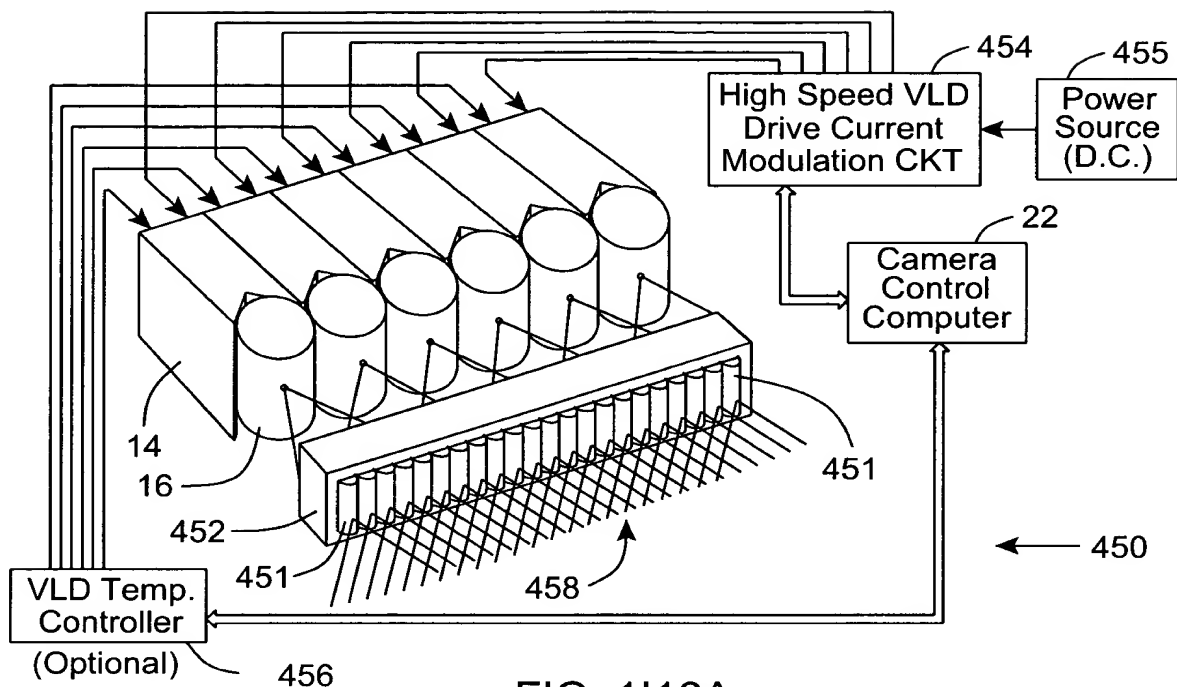


FIG. 1116A

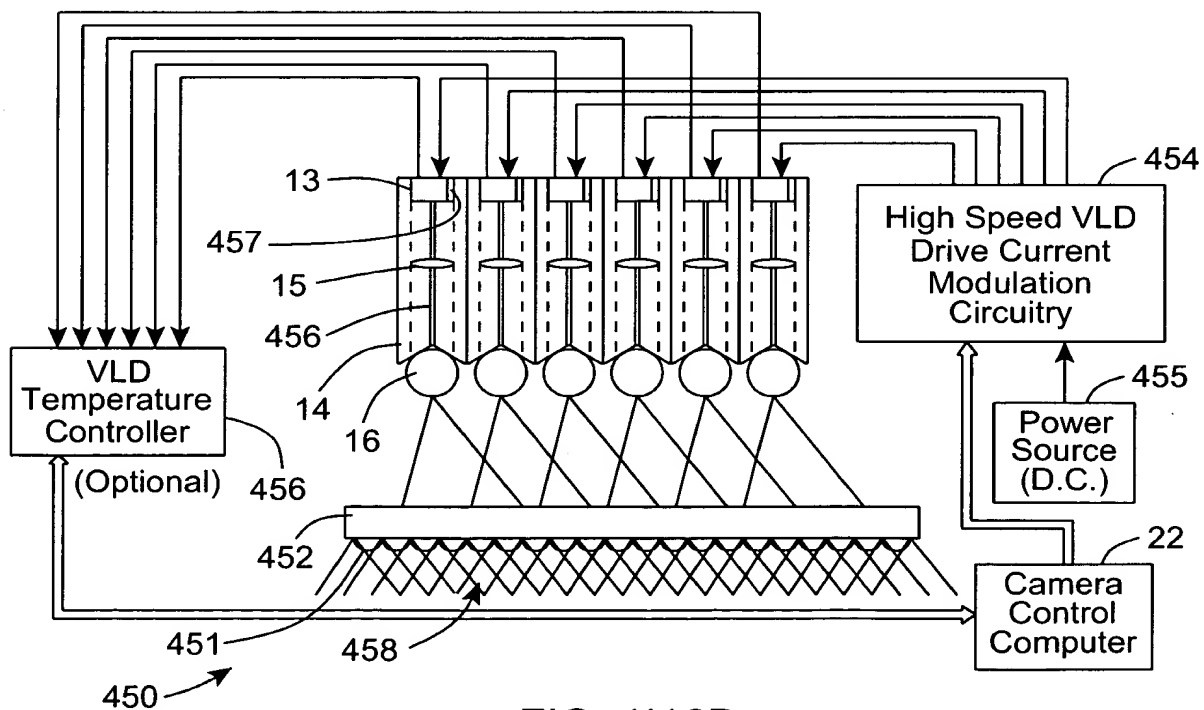


FIG. 1116B

Third Generalized Method Of
Reducing Speckle-Noise Patterns
At Image Detection Array
Of The IFD Subsystem (3)

(SPMF)

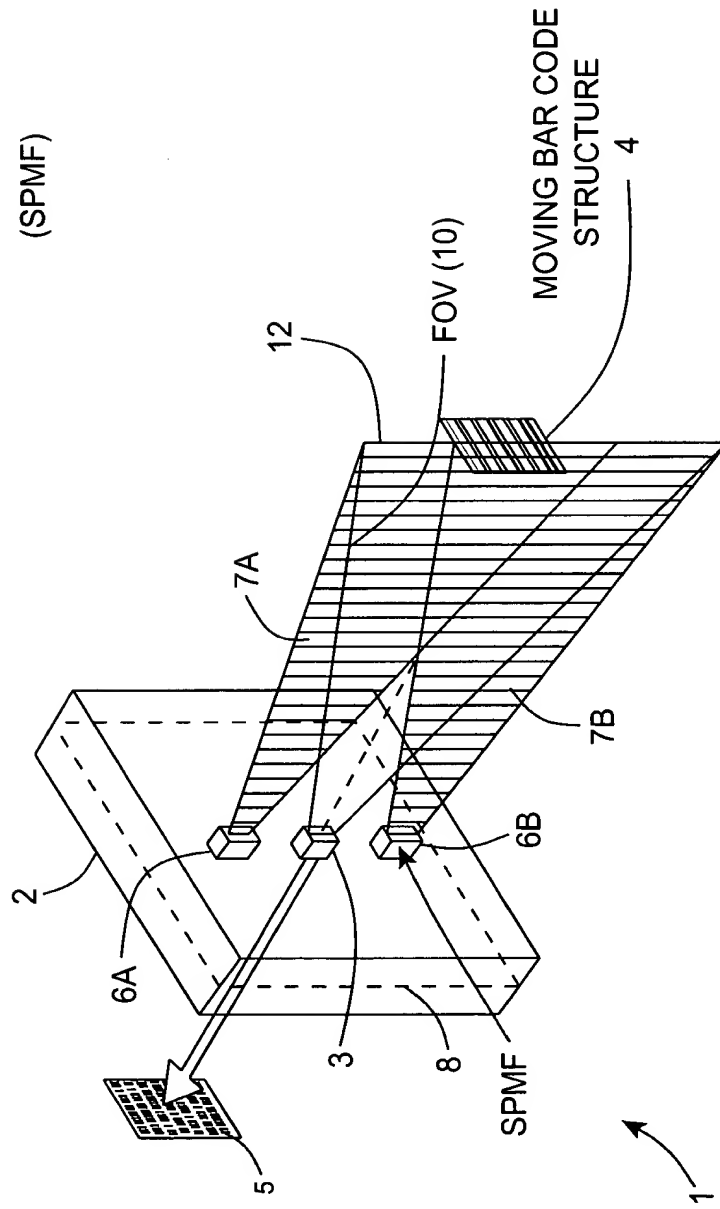
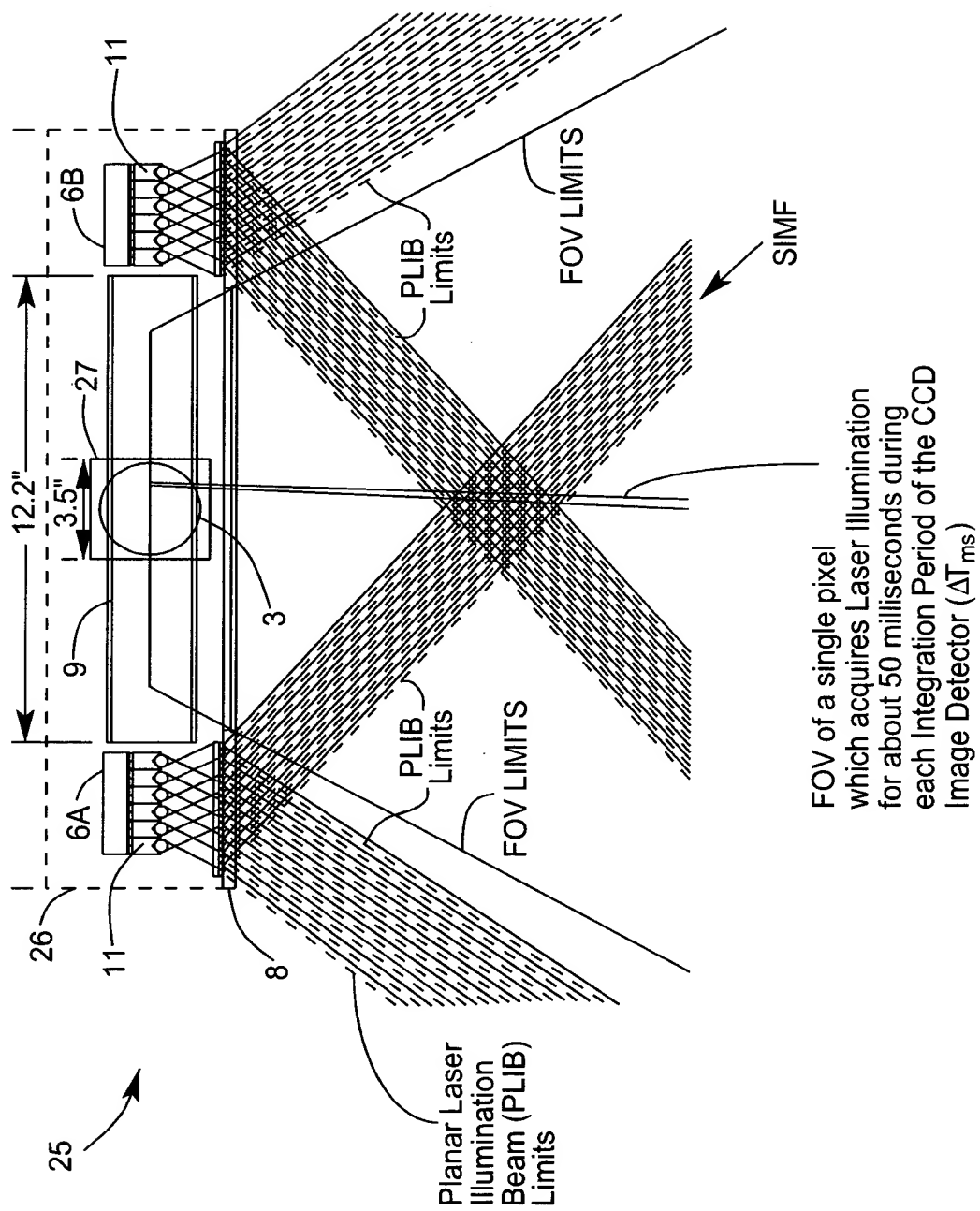


FIG. 1117



FOV of a single pixel
 which acquires Laser Illumination
 for about 50 milliseconds during
 each Integration Period of the CCD
 Image Detector (ΔT_{ms})

FIG. 1118A



THE THIRD GENERALIZED SPECKLE-NOISE PATTERN REDUCTION
METHOD OF THE PRESENT INVENTION

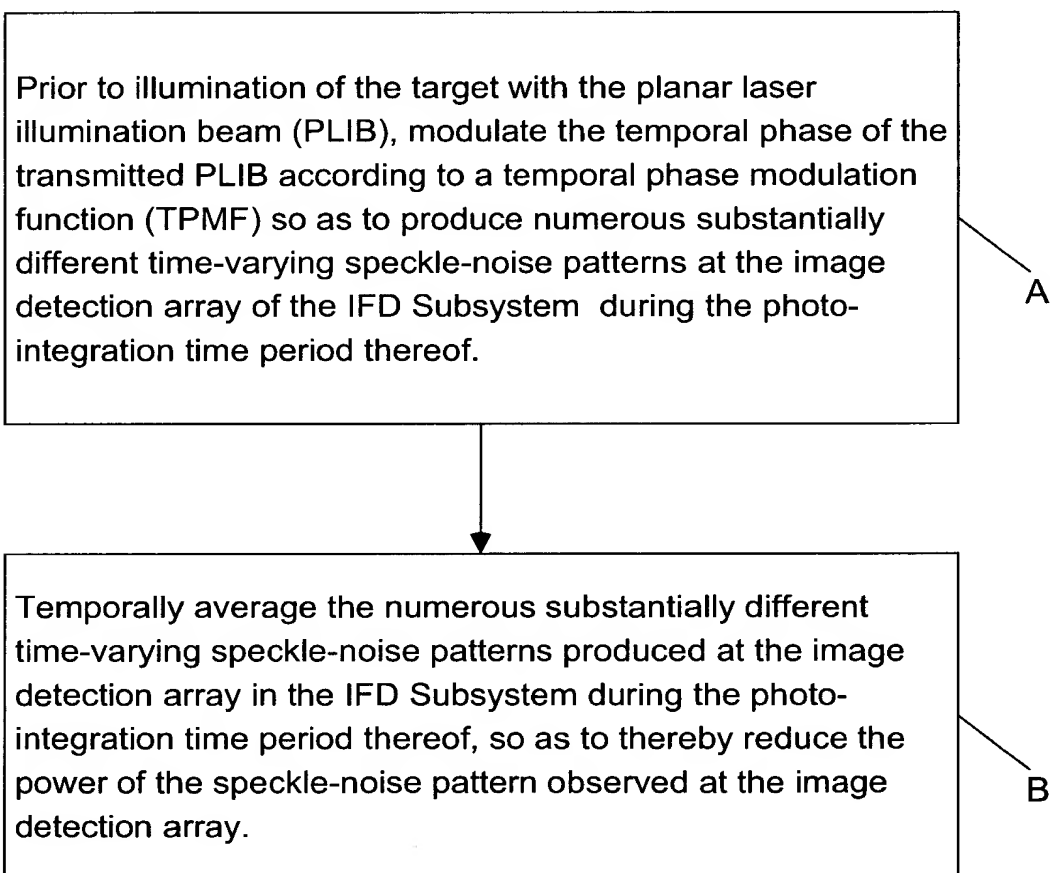
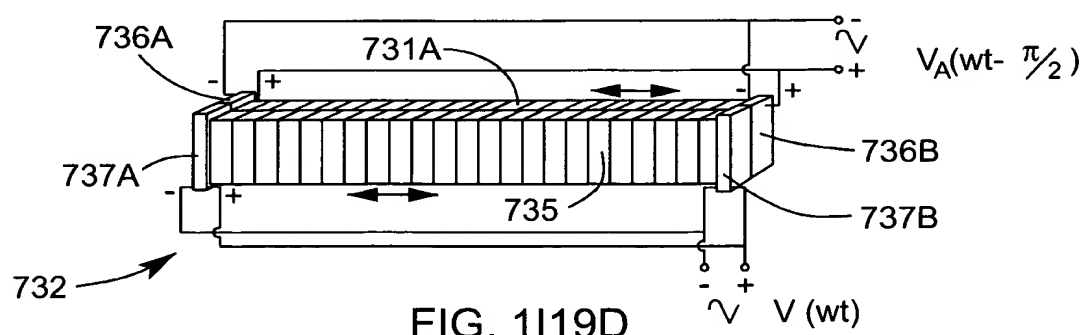
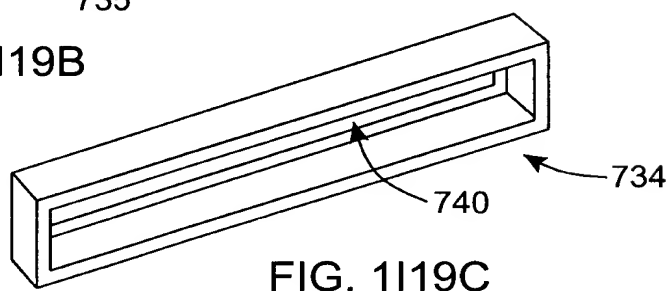
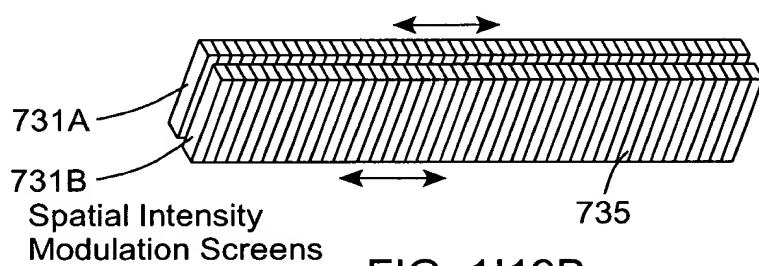
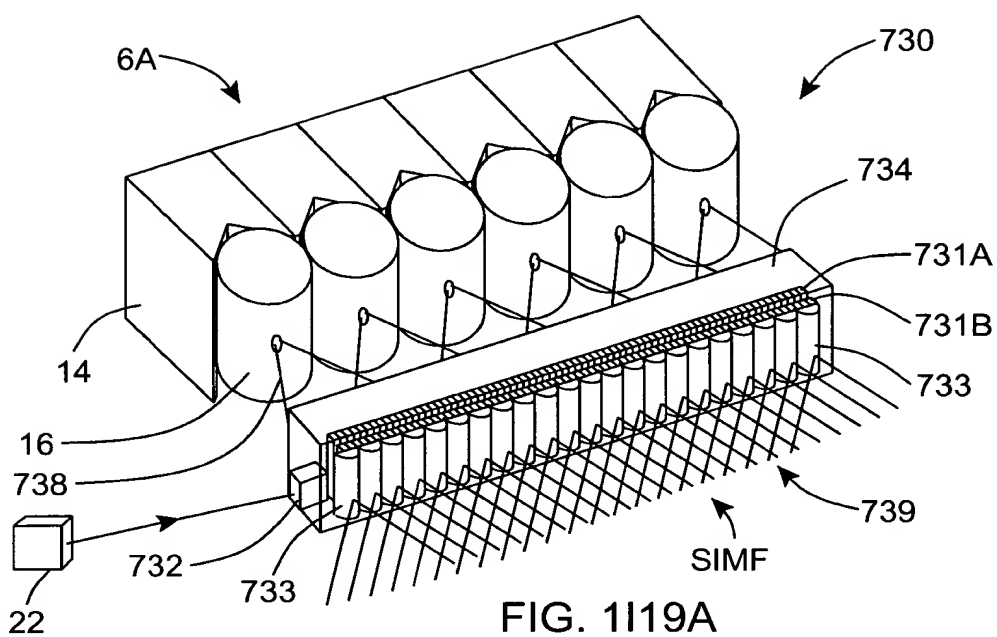
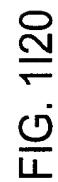
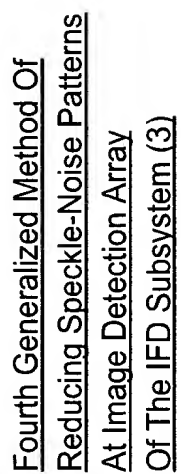
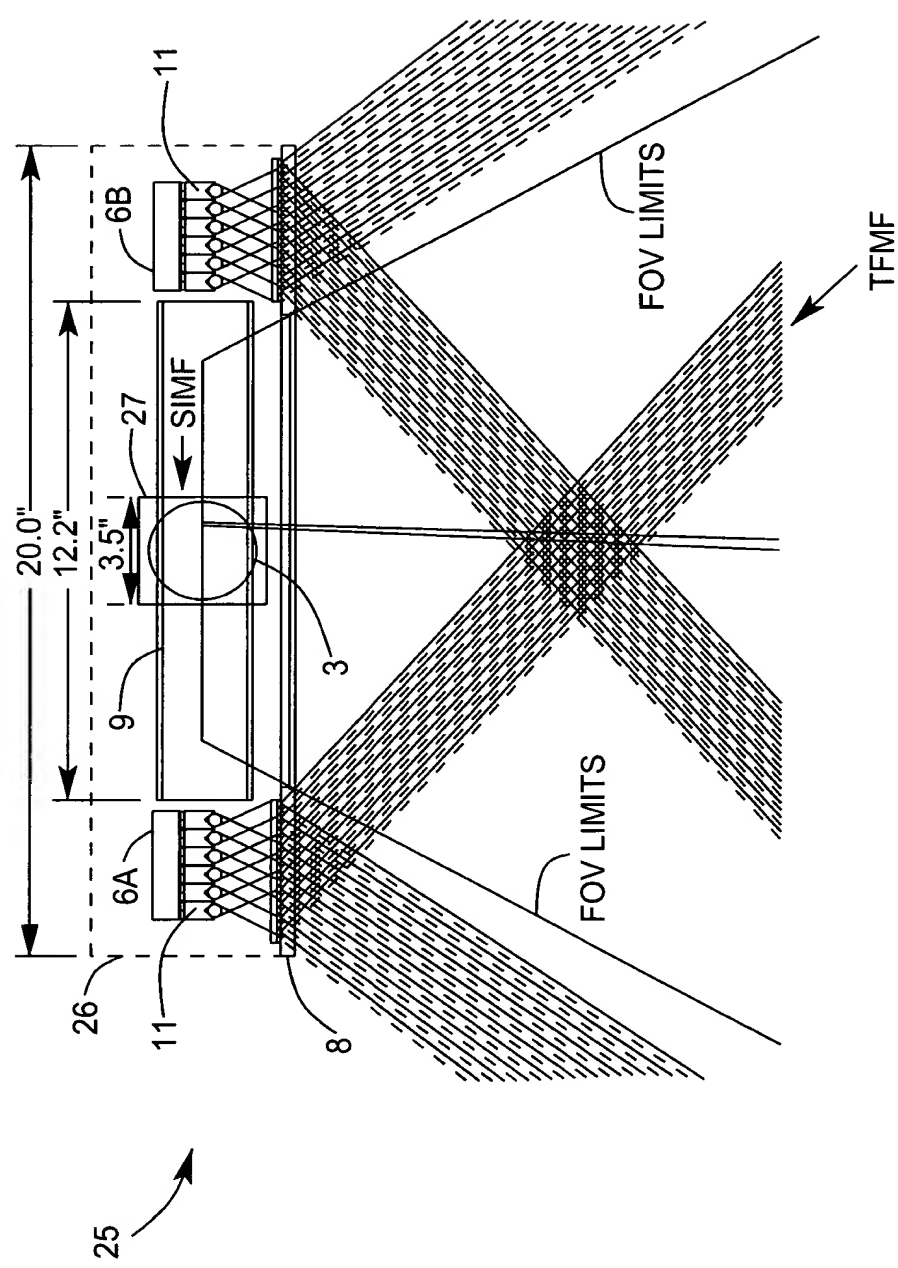


FIG. 1I18B









THE FOURTH GENERALIZED SPECKLE-NOISE PATTERN REDUCTION
METHOD OF THE PRESENT INVENTION

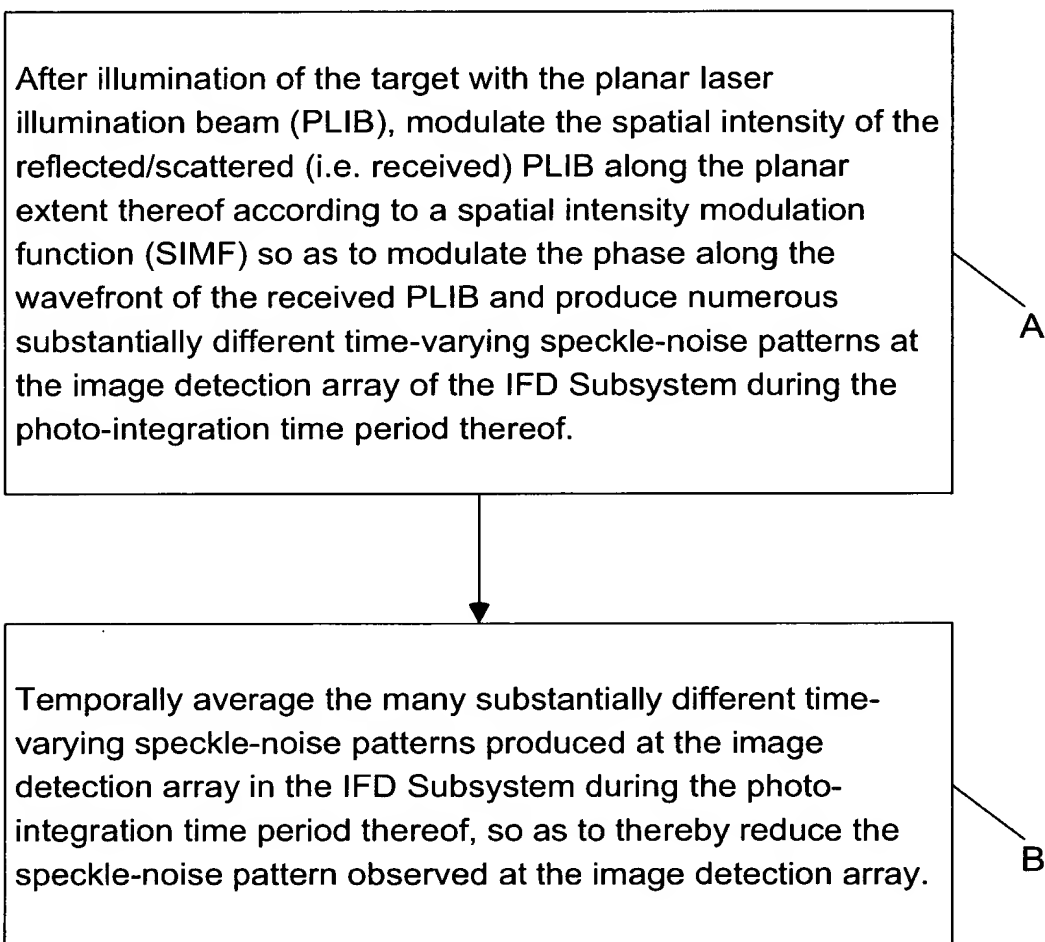


FIG. 1I21B

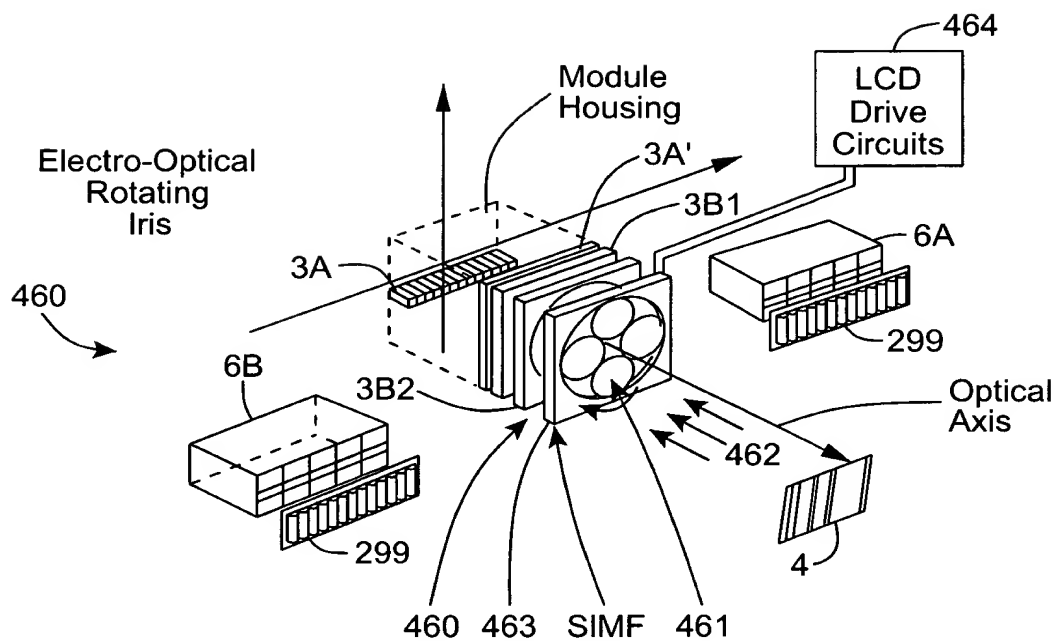


FIG. 1122A

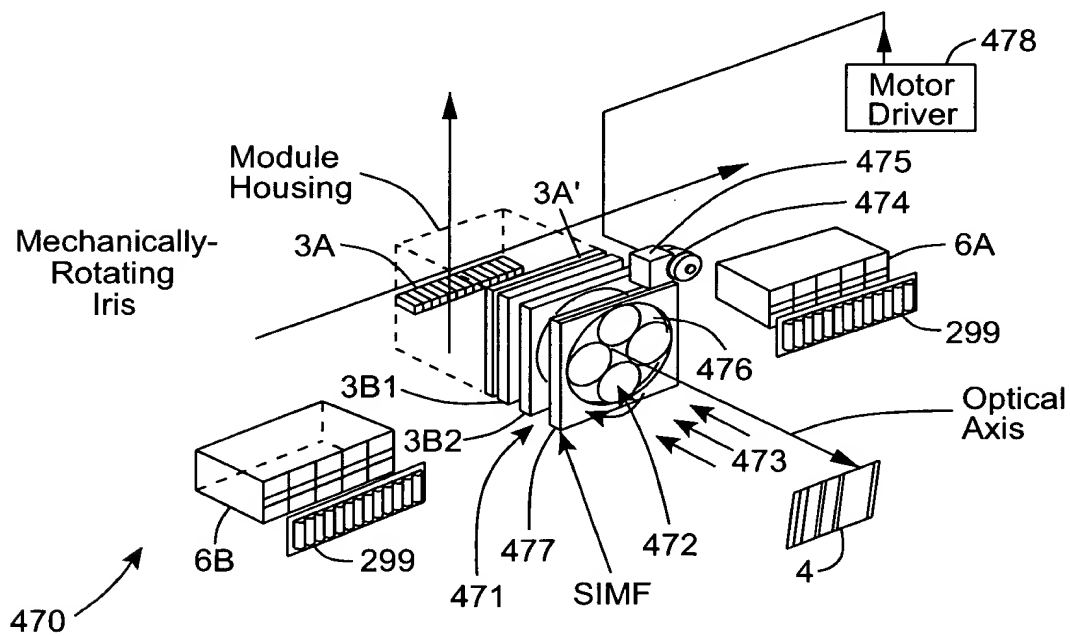


FIG. 1122B



Fifth Generalized Method Of
Reducing Speckle-Noise Patterns
At Image Detection Array
Of The IFD Subsystem (3)

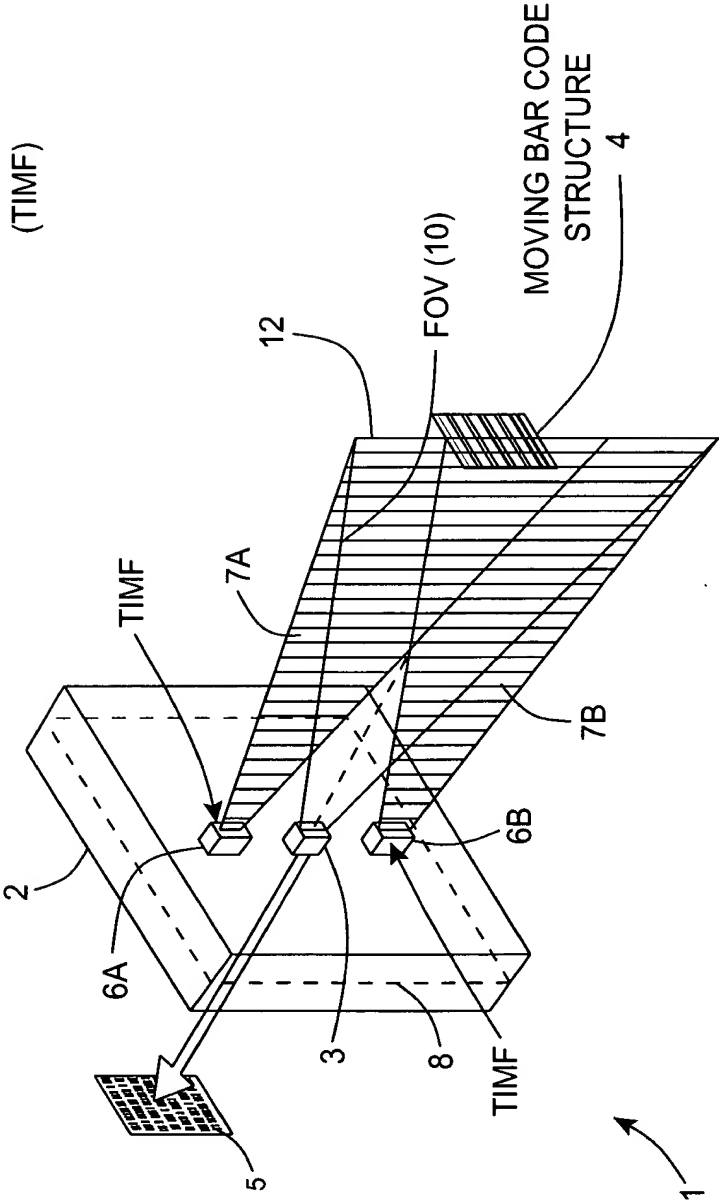
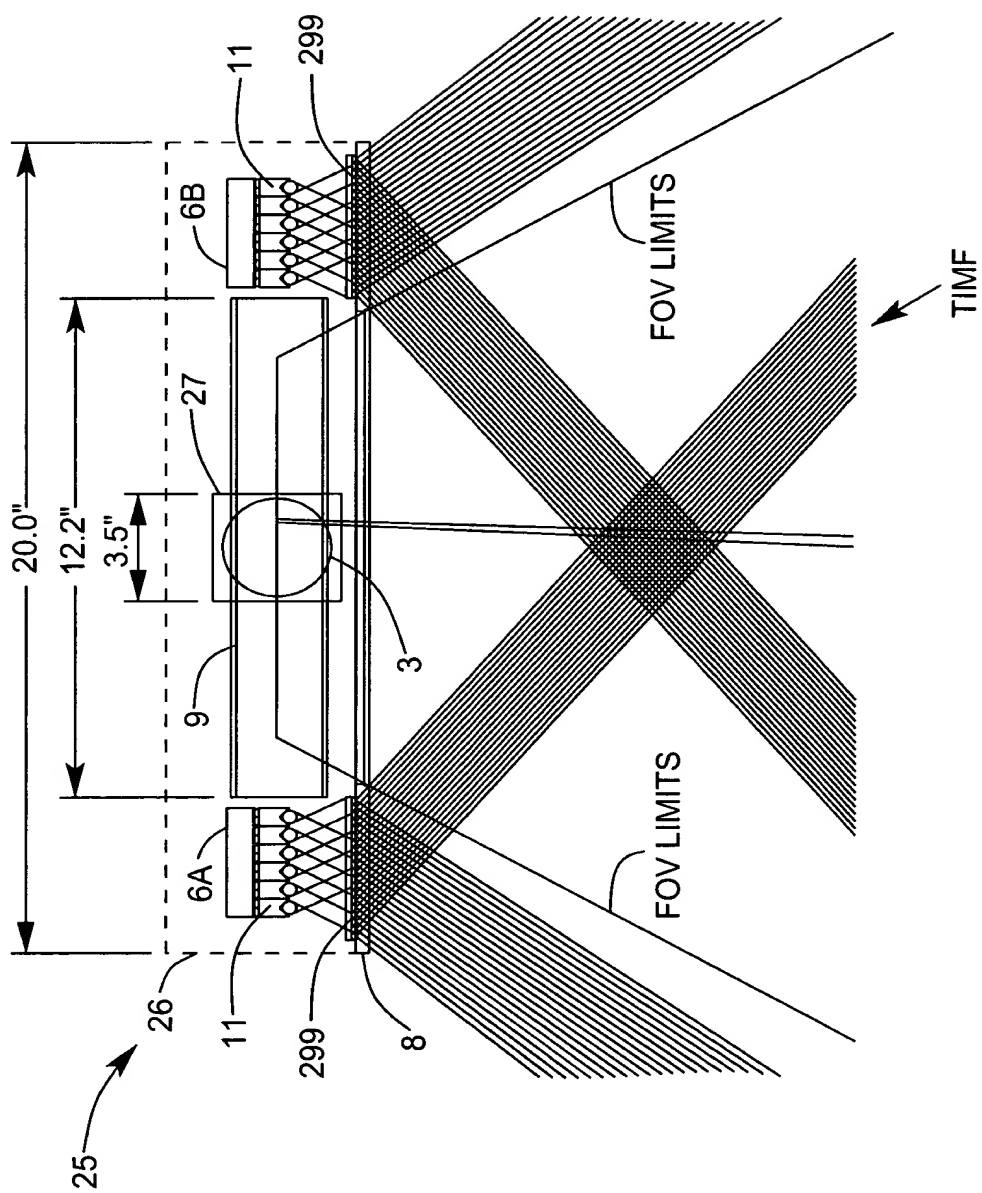


FIG. 1123





THE FIFTH GENERALIZED SPECKLE-NOISE PATTERN REDUCTION
METHOD OF THE PRESENT INVENTION

After illumination of the target with the planar laser illumination beam (PLIB), modulate the temporal intensity of the reflected/scattered (i.e. received) PLIB along the planar extent thereof according to a temporal intensity modulation function (TIMF) so as to modulate the phase along the wavefront of the received PLIB and produce many substantially different time-varying speckle-noise patterns at the image detection array of the IFD Subsystem during the photo-integration time period thereof.

A

Temporally average the many substantially different time-varying speckle-noise patterns produced at the image detection array in the IFD Subsystem during the photo-integration time period thereof, so as to thereby reduce the speckle-noise pattern observed at the image detection array.

B

FIG. 1I24B

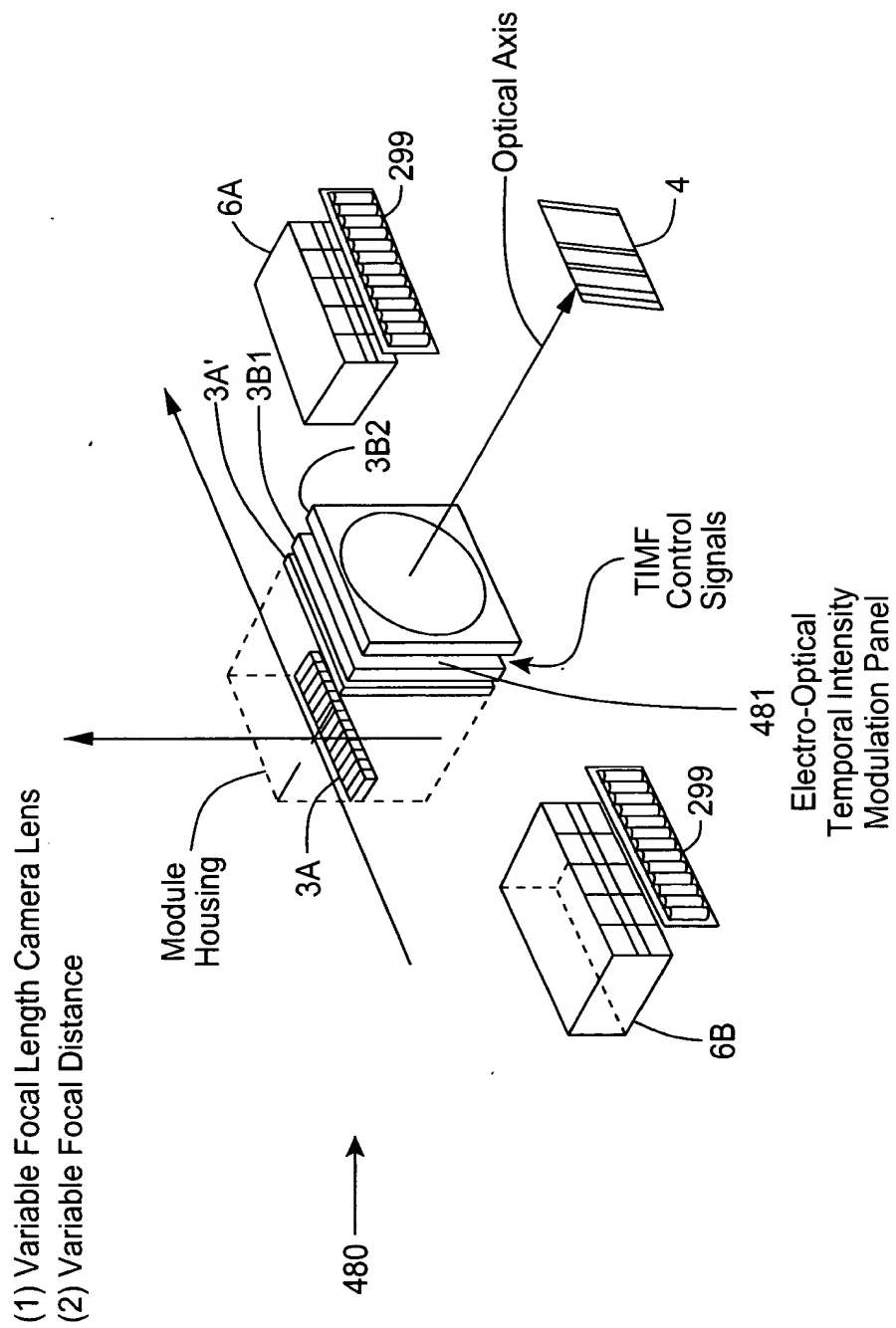


FIG. 1125

Fixed Focal Length
Lens Cases

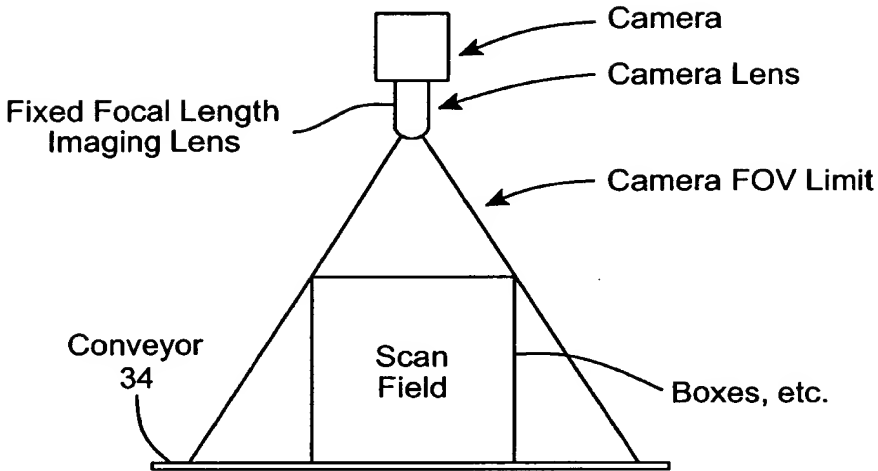


FIG. 1K1

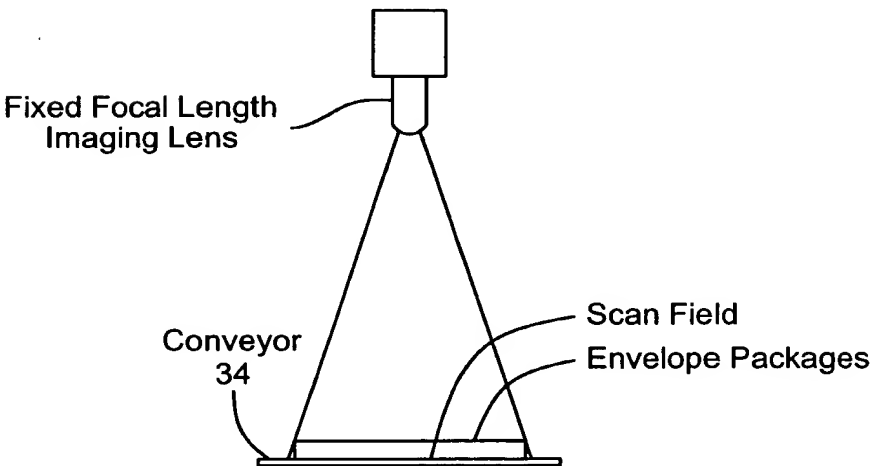


FIG. 1K2

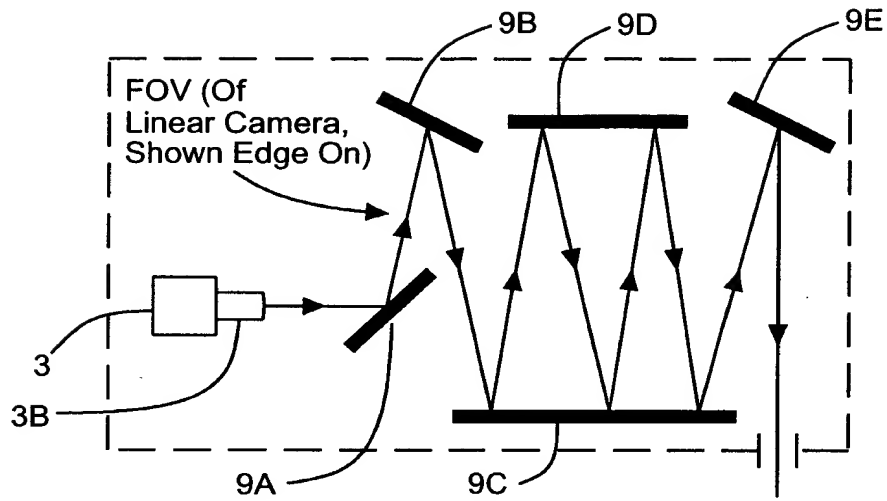


FIG. 1L1

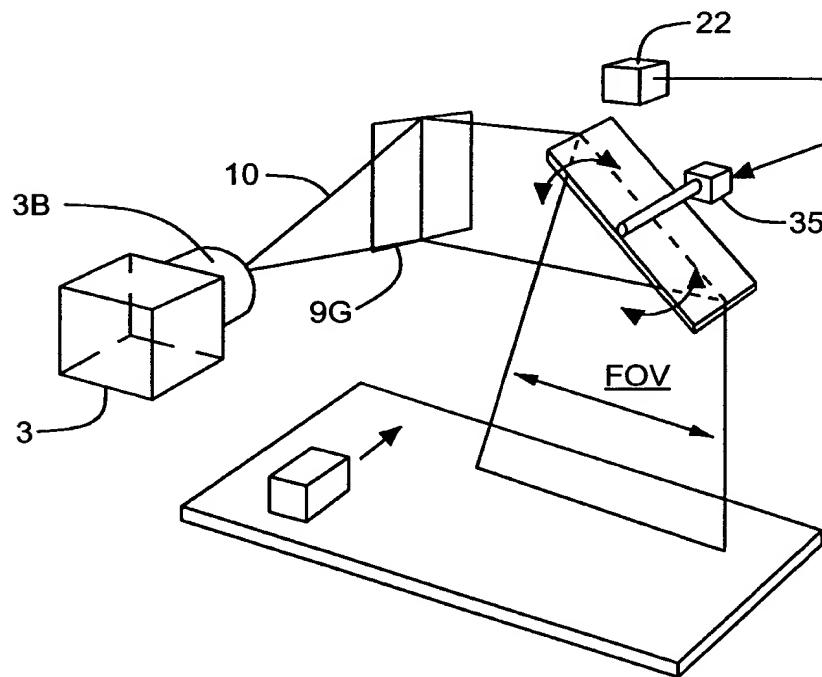


FIG. 1L2



Pixel Power Density vs. Object Distance (General Example)

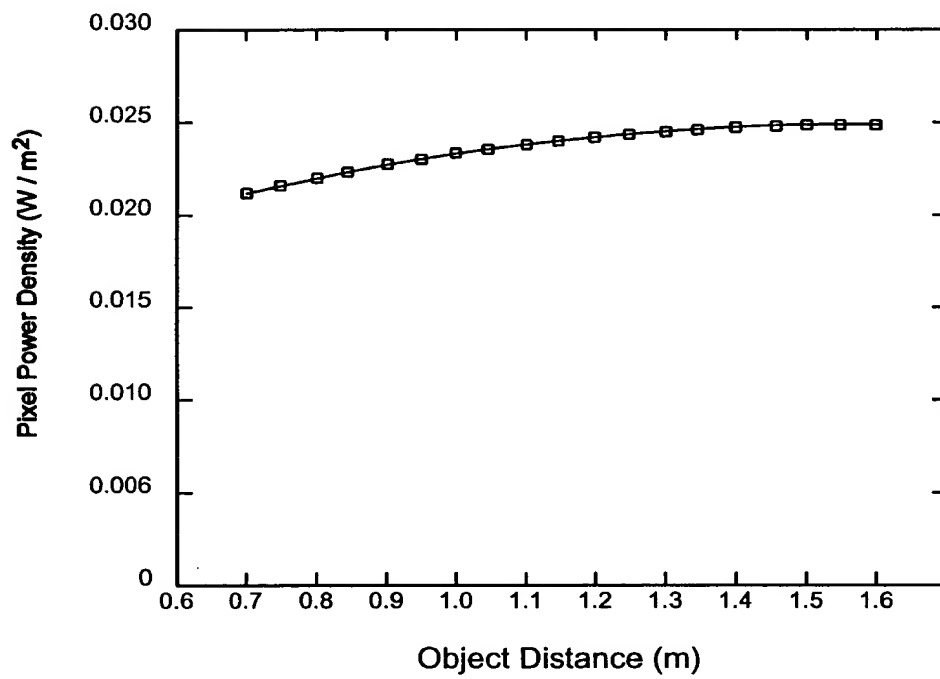


FIG. 1M1

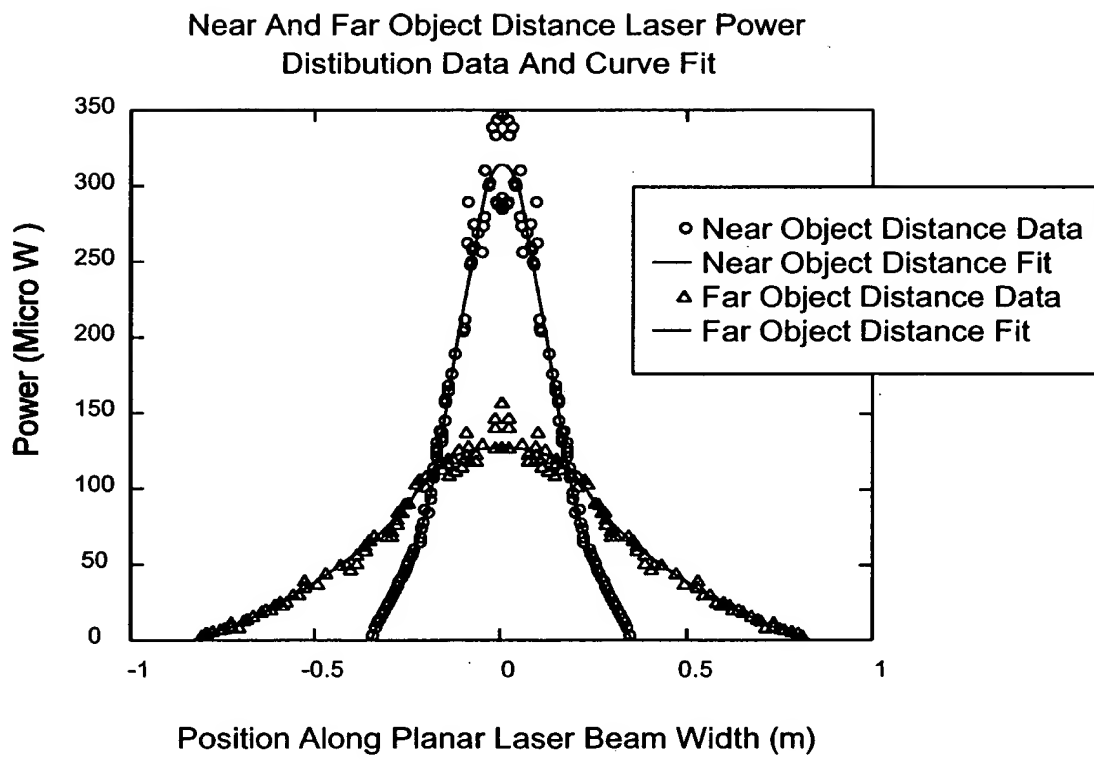


FIG. 1M2



Planar Laser Beam Width vs. Object Distance

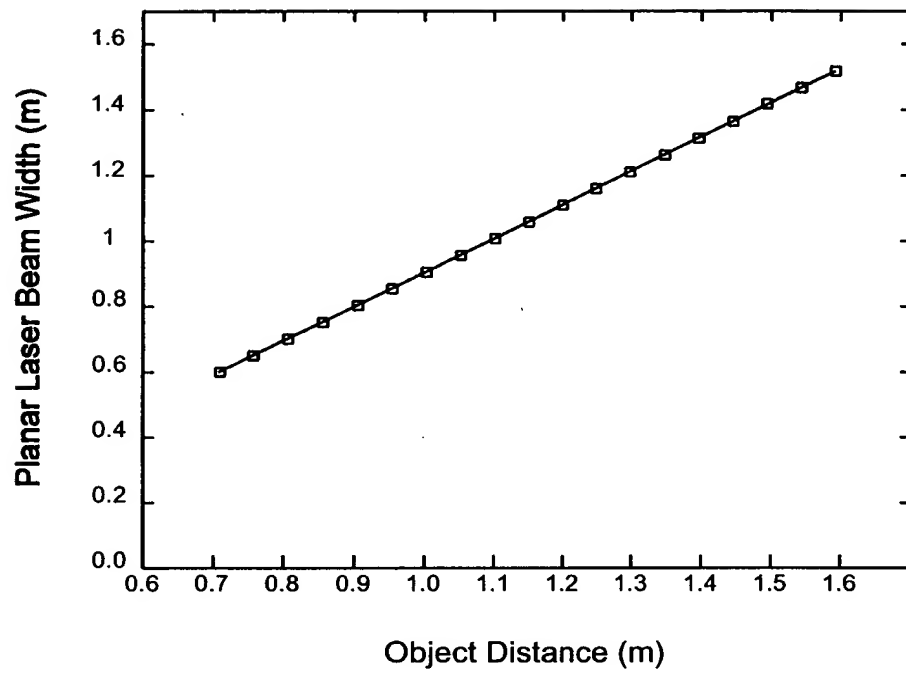
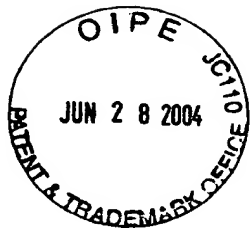


FIG. 1M3



Planar Laser Beam Height vs.
Object Distance (Far Object Distance Focus)

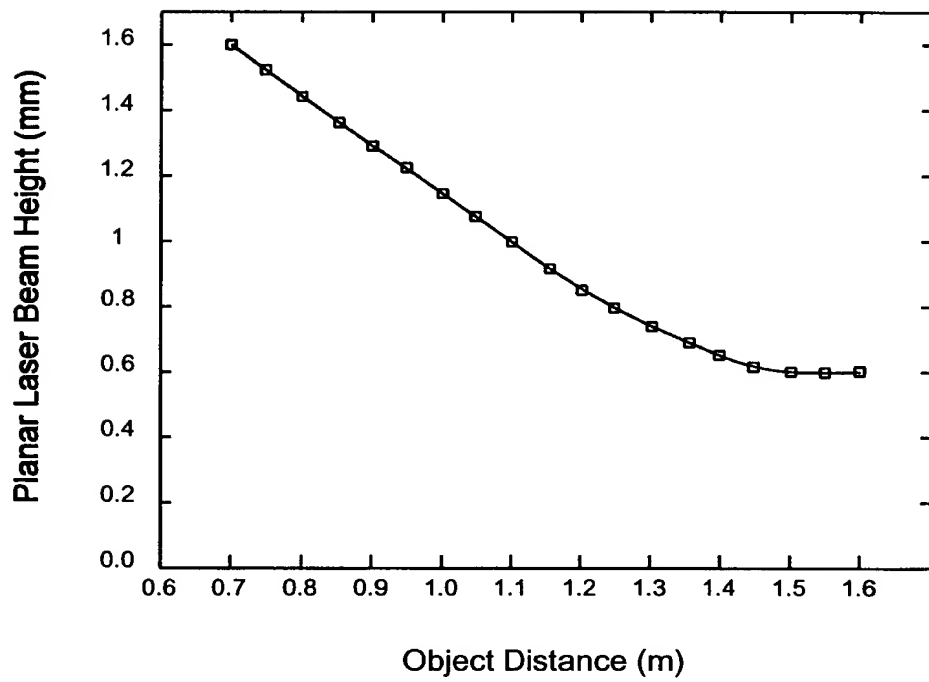


FIG. 1M4

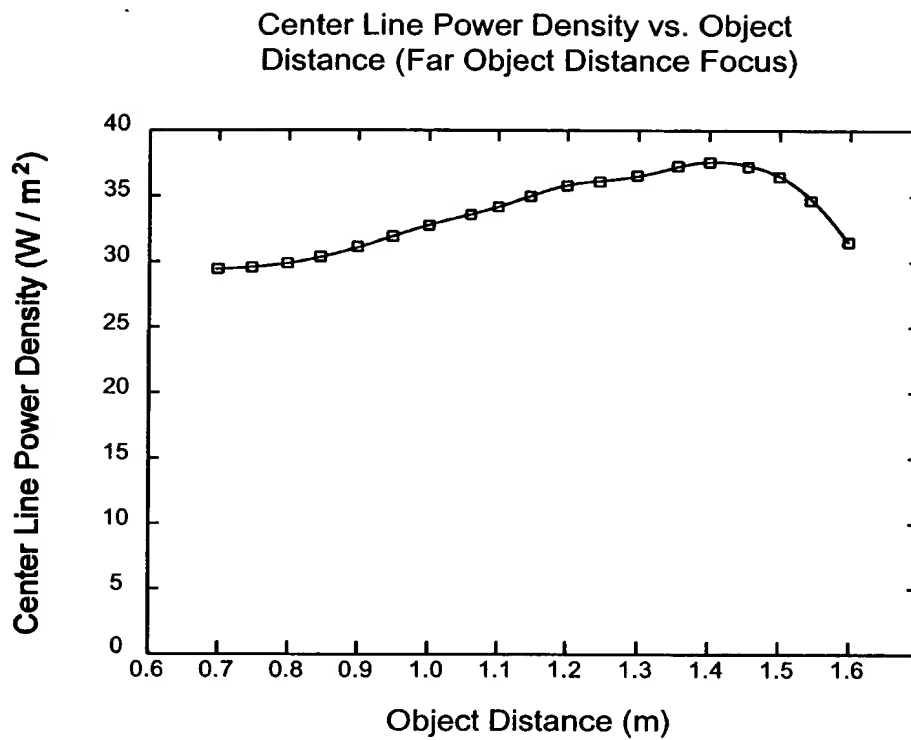
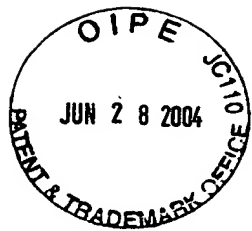


FIG. 1N

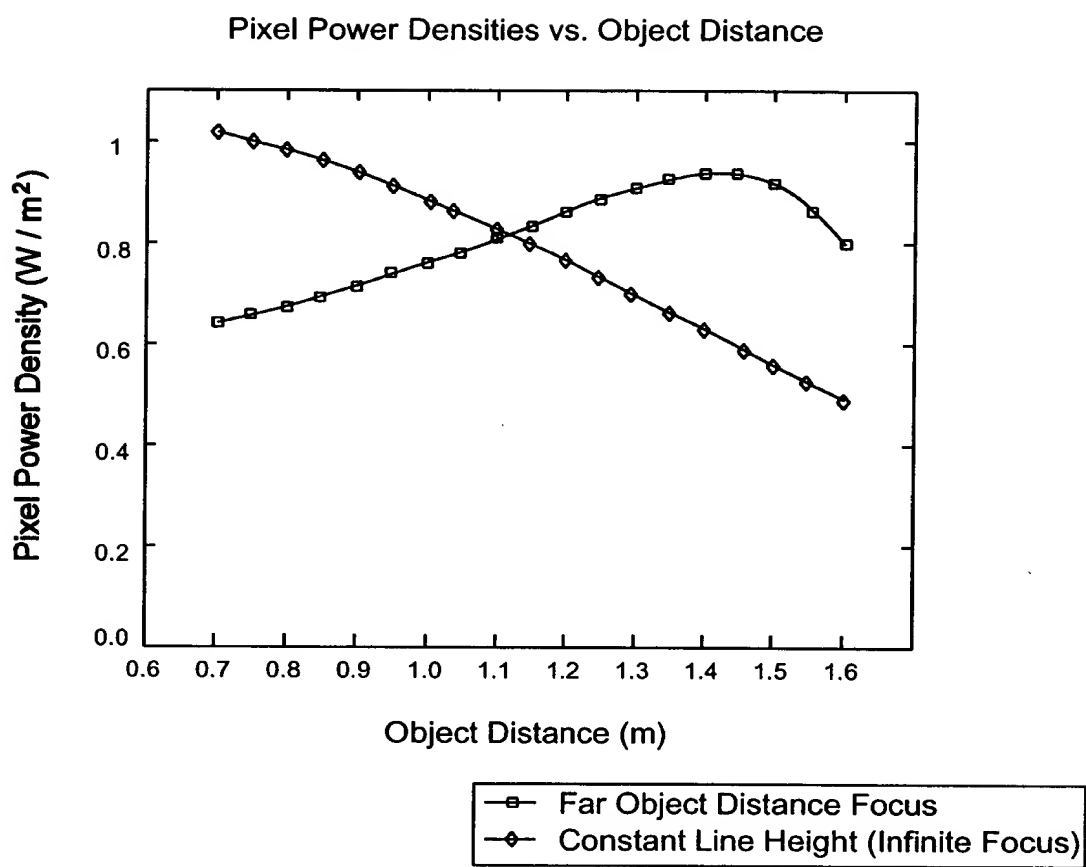


FIG. 10

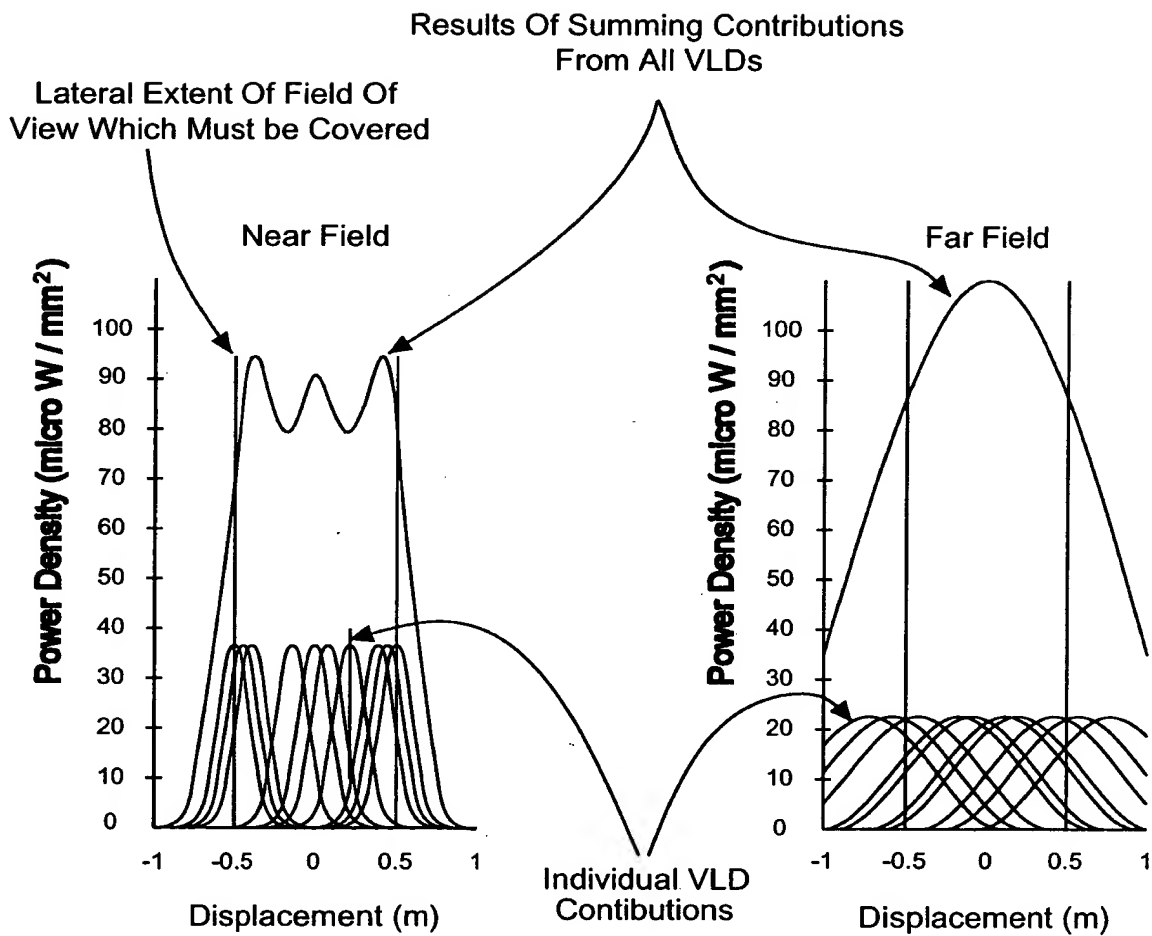


FIG. 1P1

FIG. 1P2

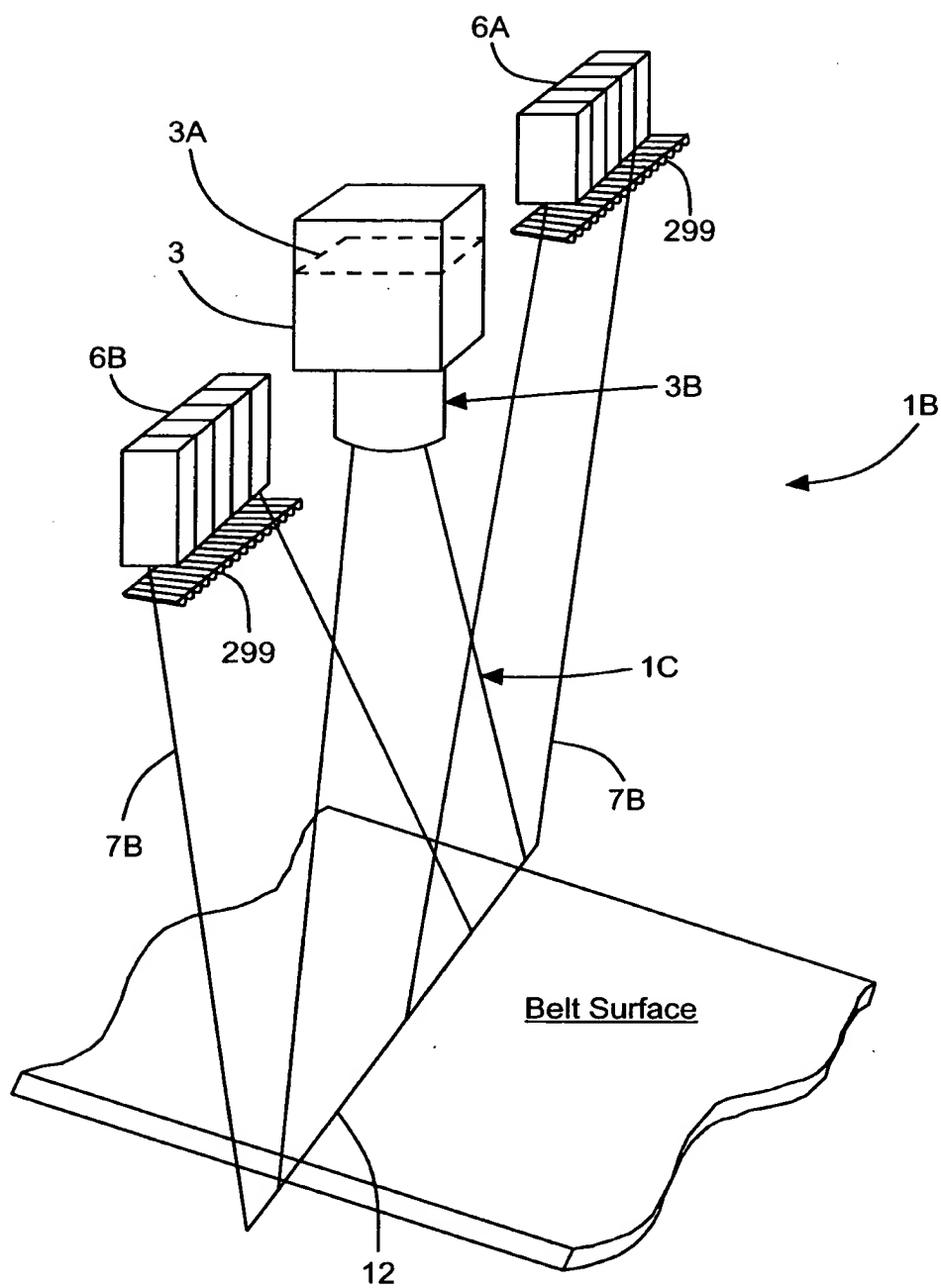


FIG. 1Q1

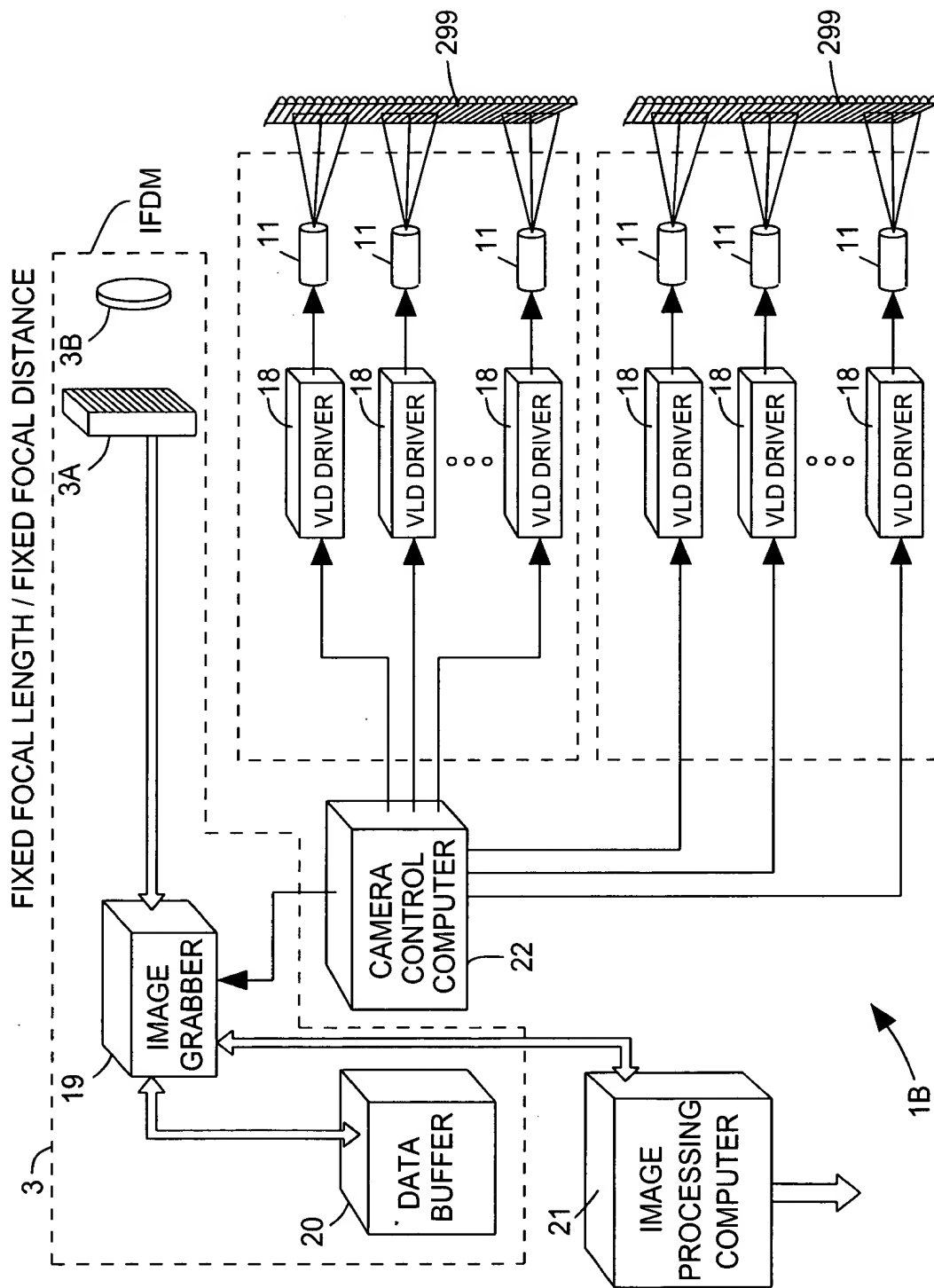


FIG. 1Q2

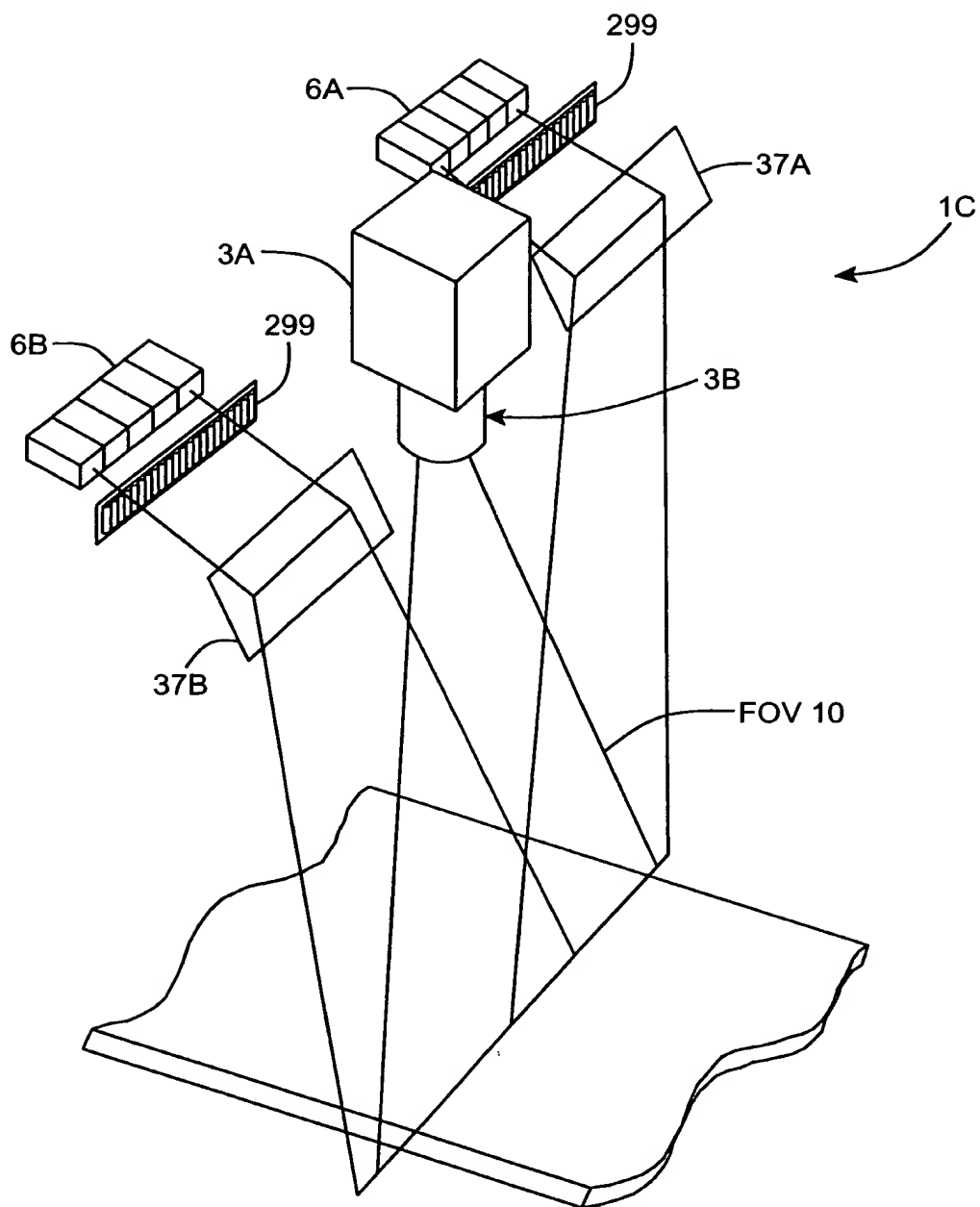


FIG. 1R1

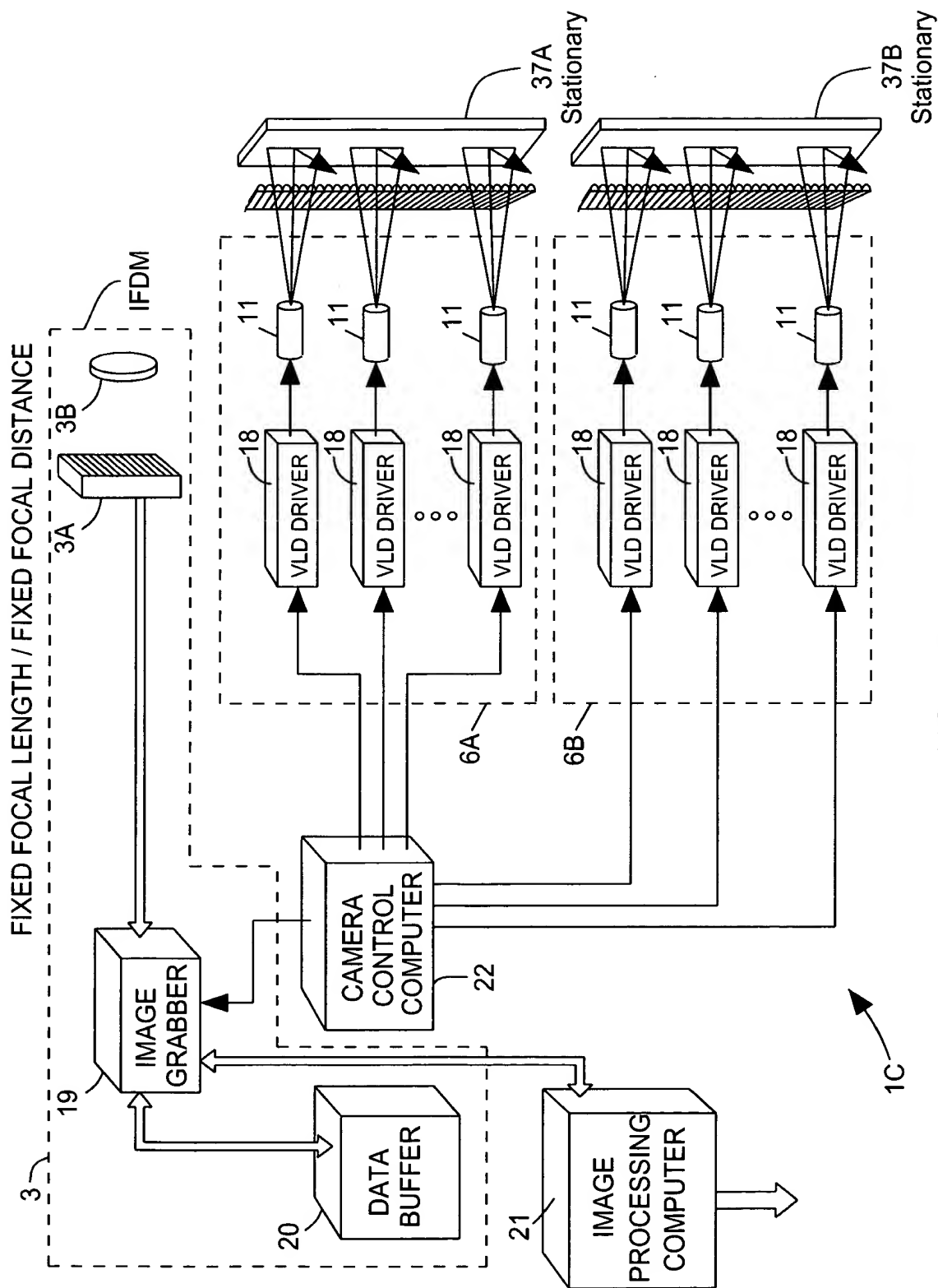


FIG. 1R2

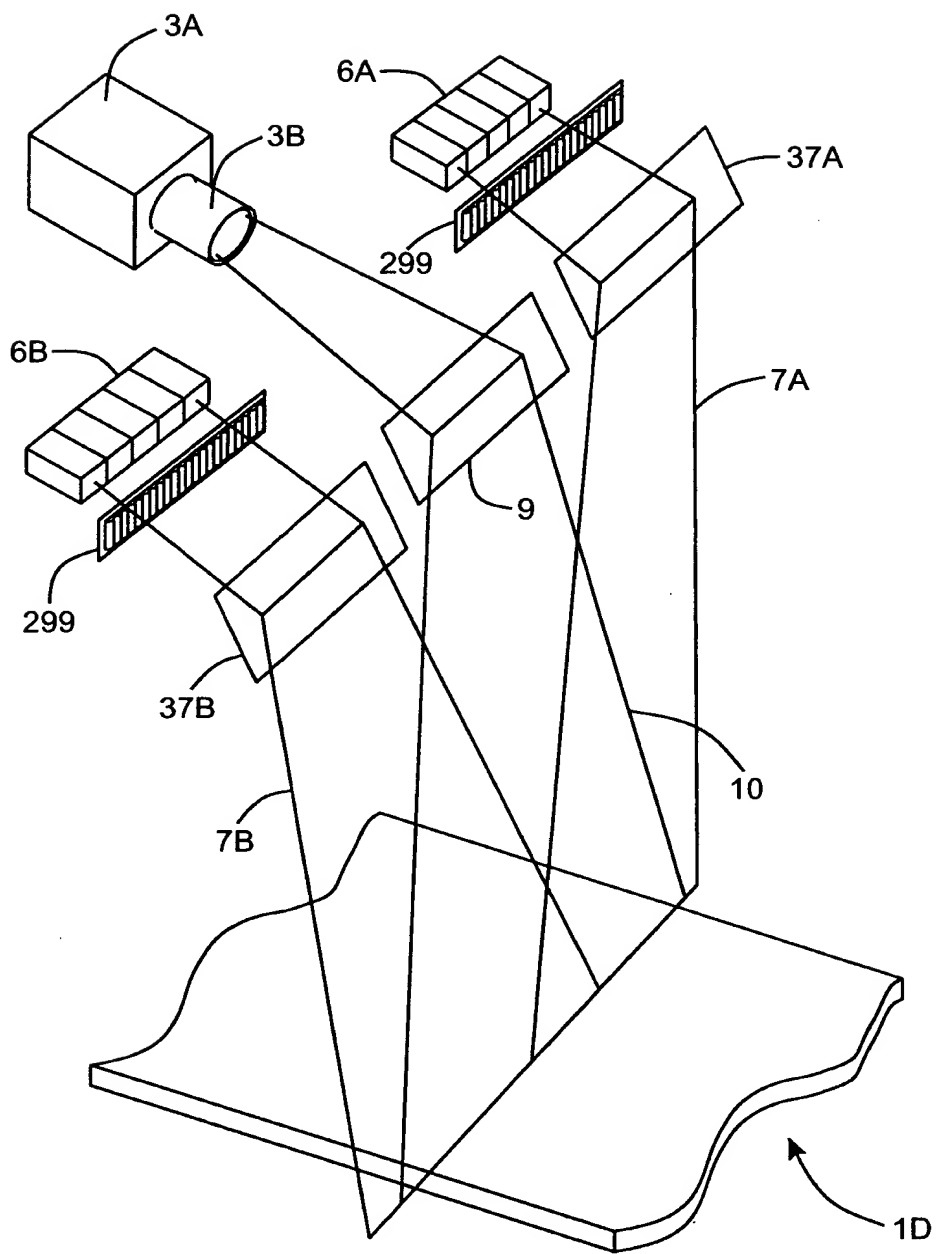
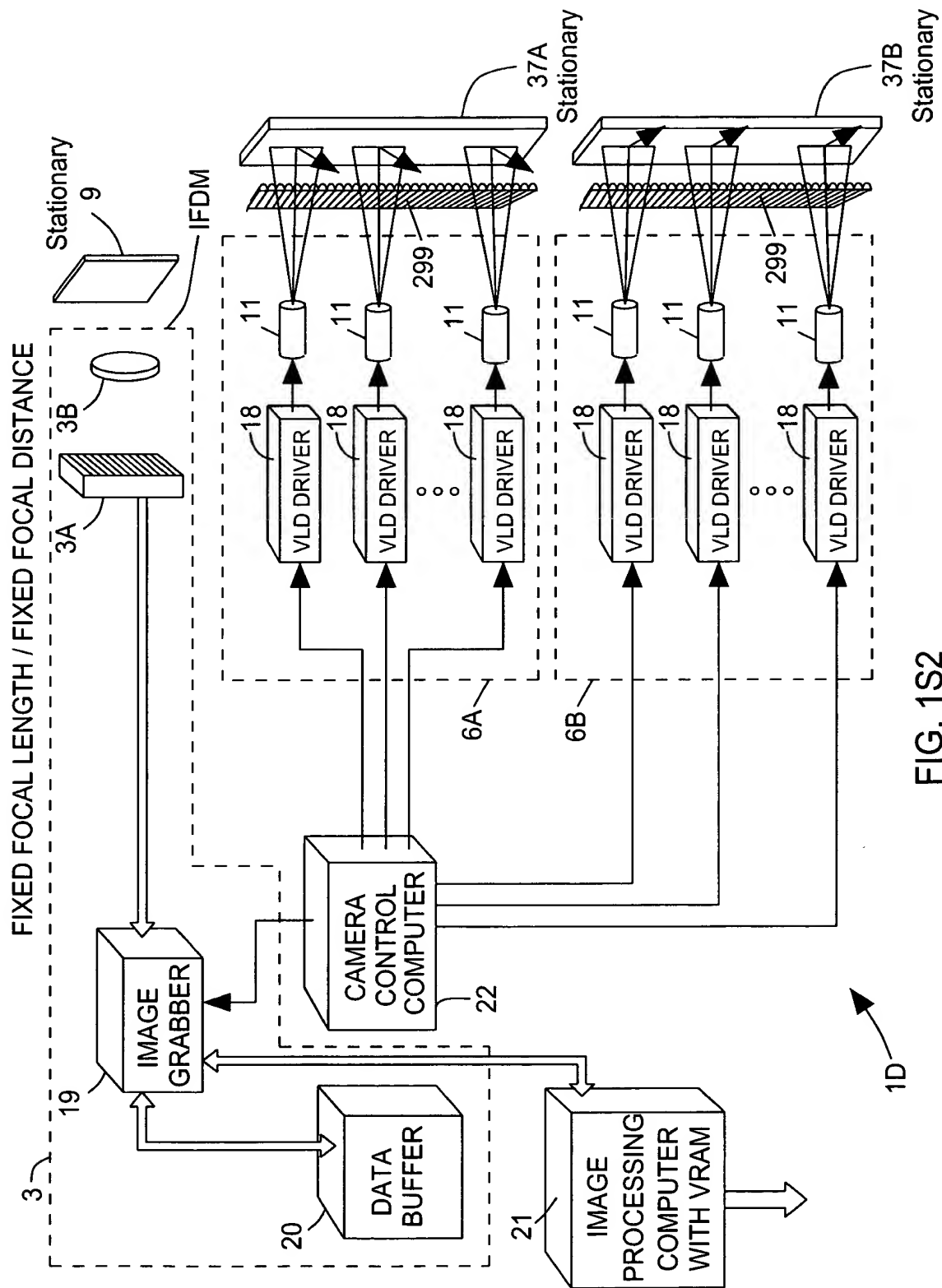


FIG. 1S1



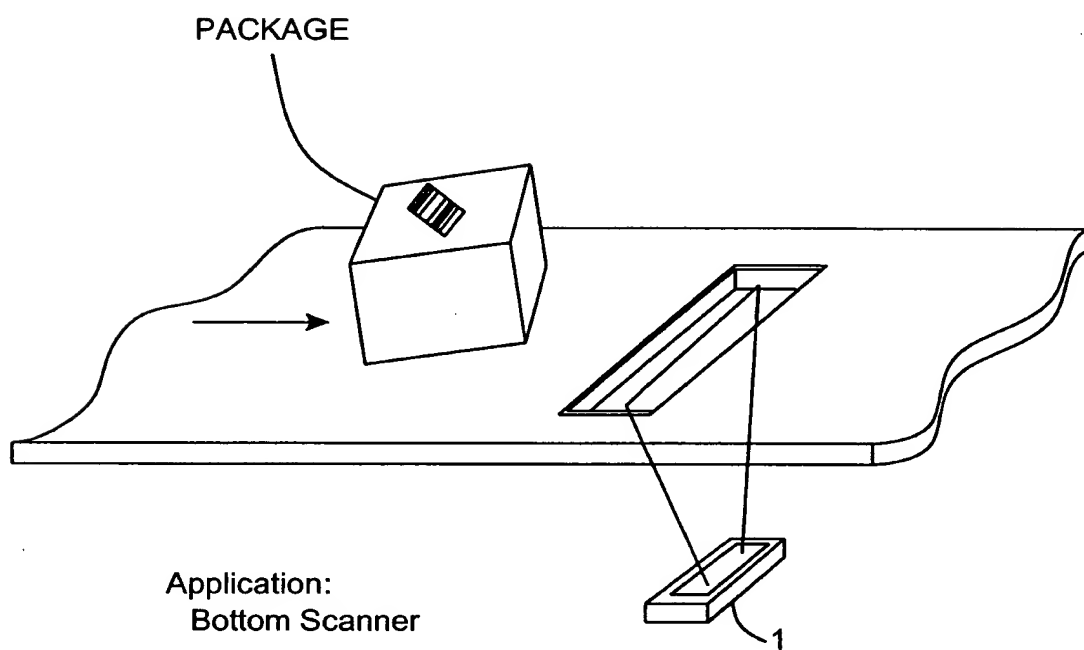
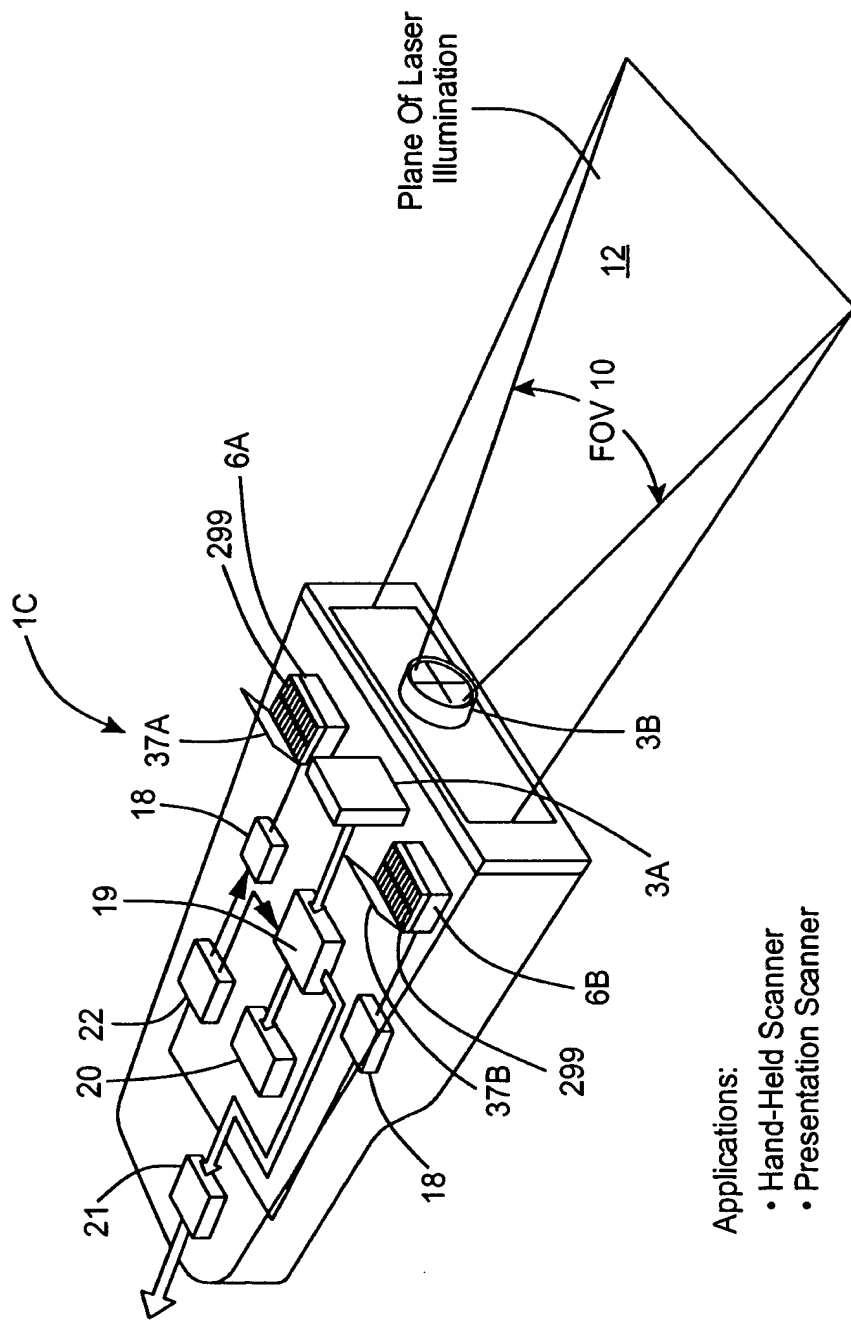
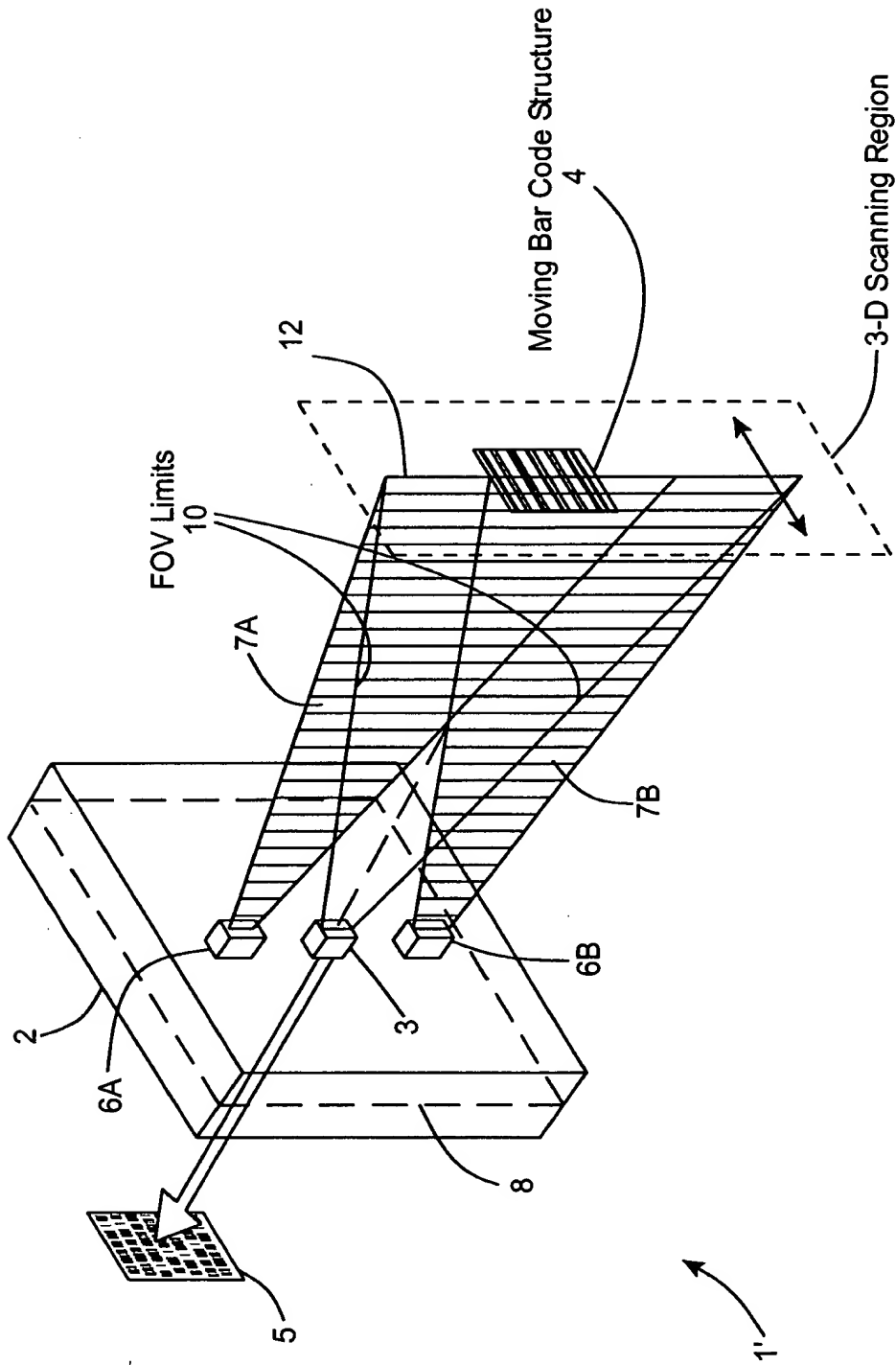


FIG. 1T



Applications:
 • Hand-Held Scanner
 • Presentation Scanner

FIG. 1U



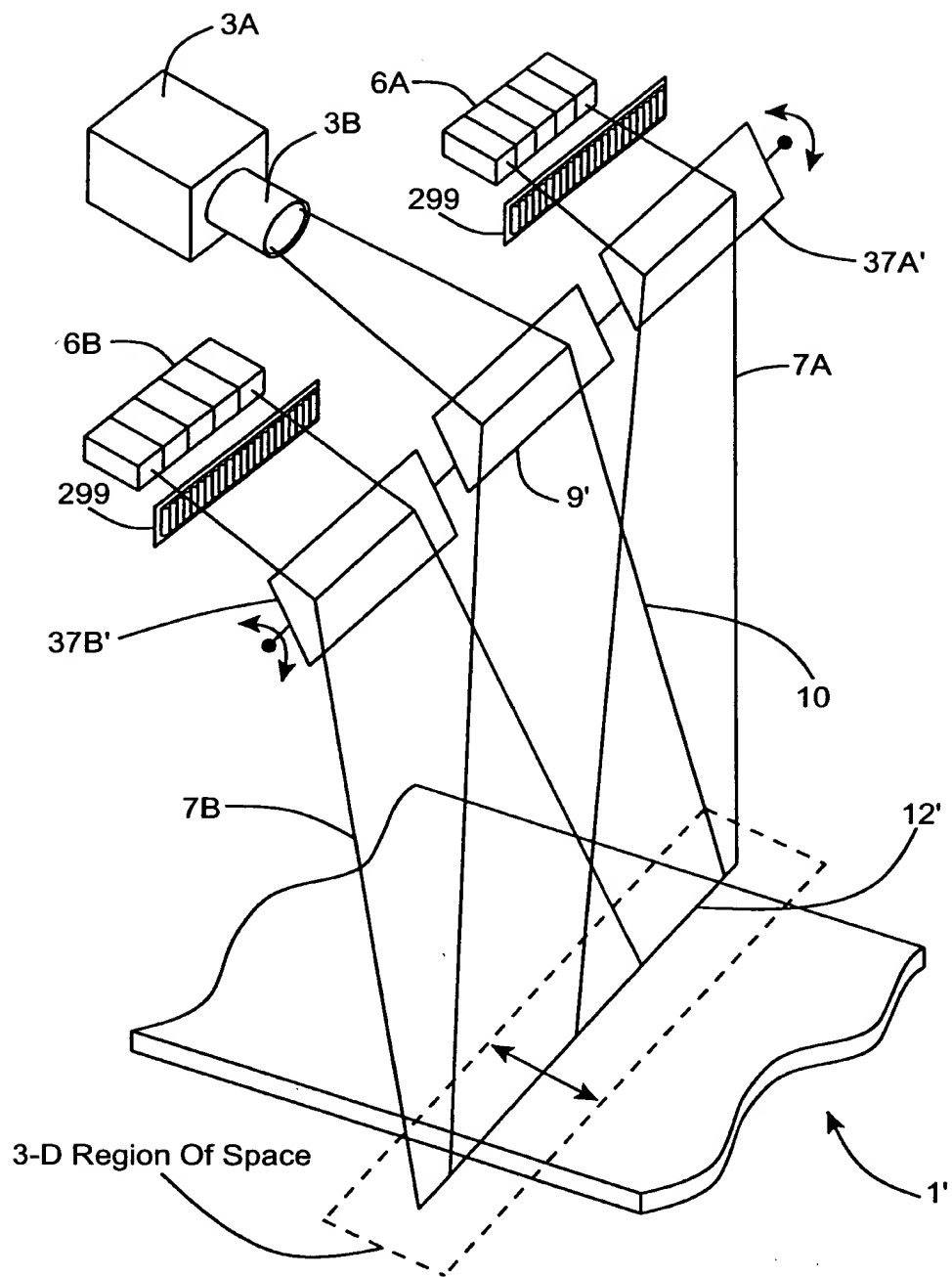


FIG. 1V2

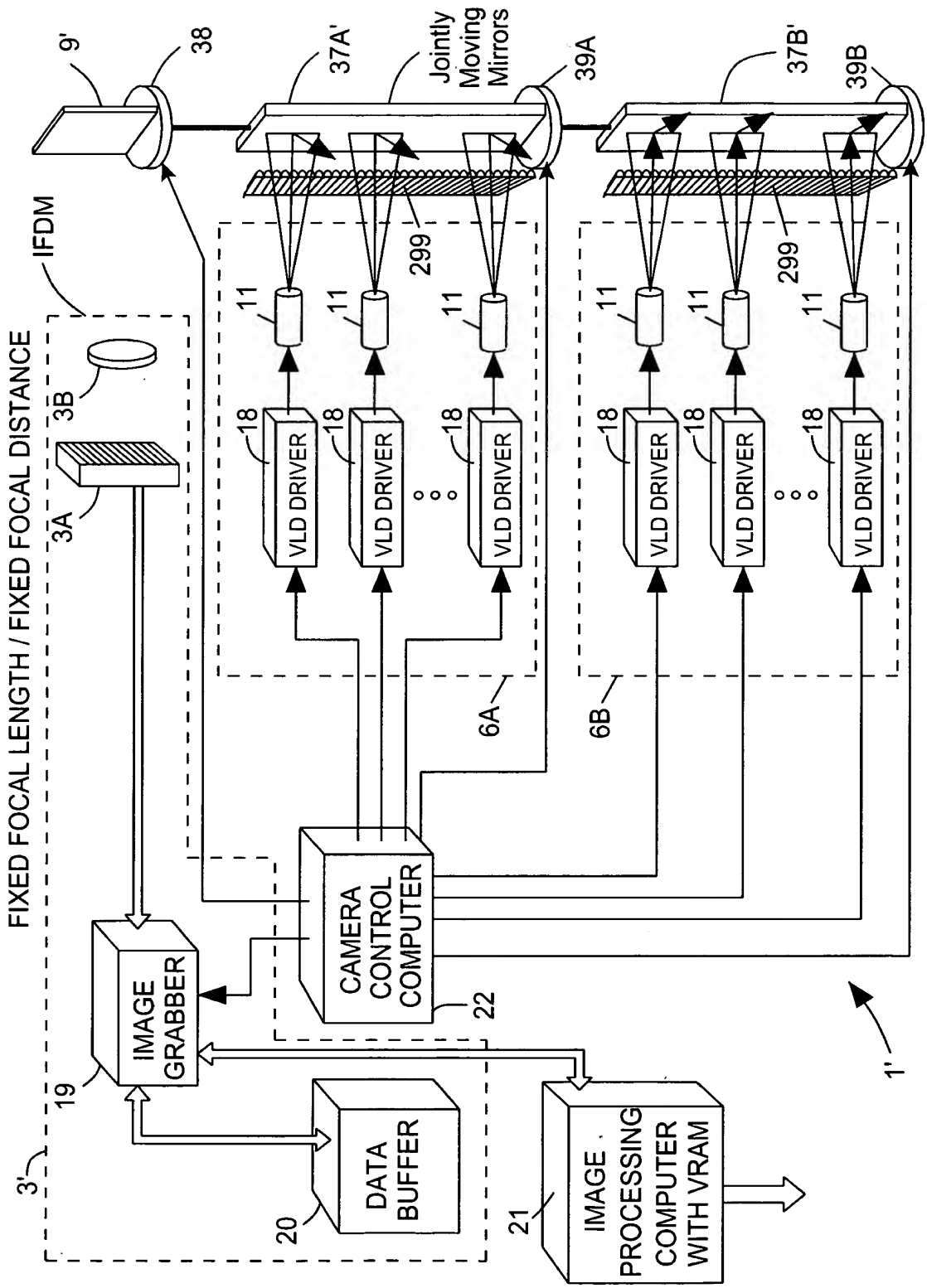
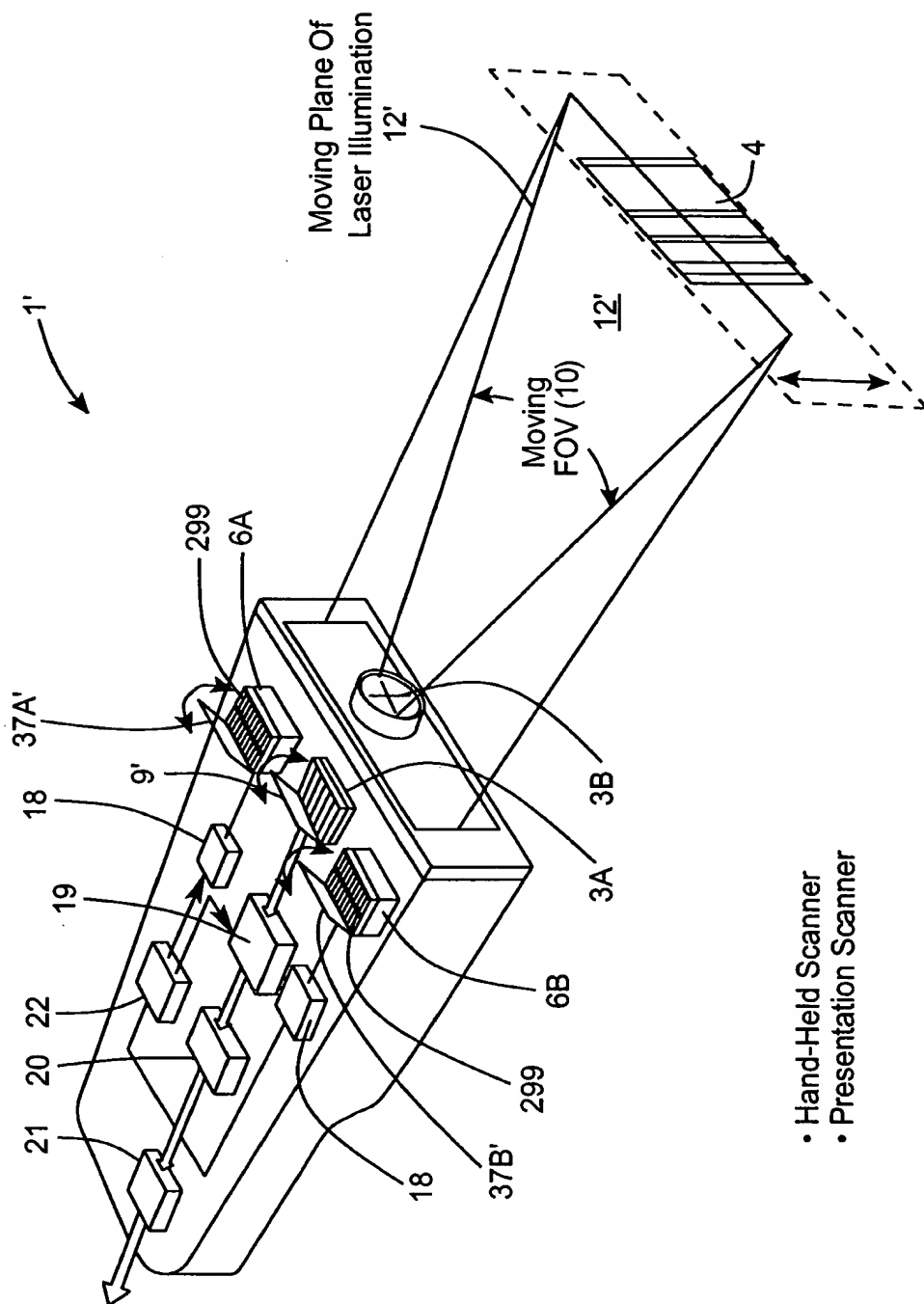
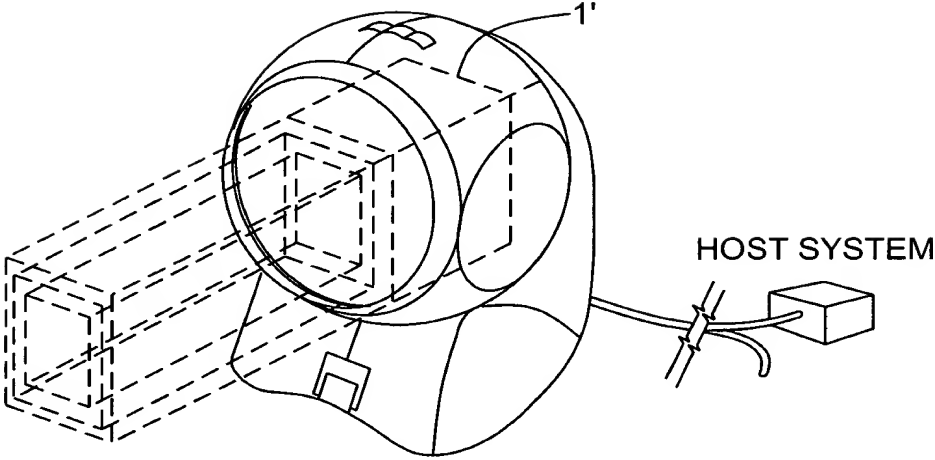


FIG. 1V3



- Hand-Held Scanner
- Presentation Scanner

FIG. 1V4



PRESENTATION TYPE SCANNER

FIG. 1V5

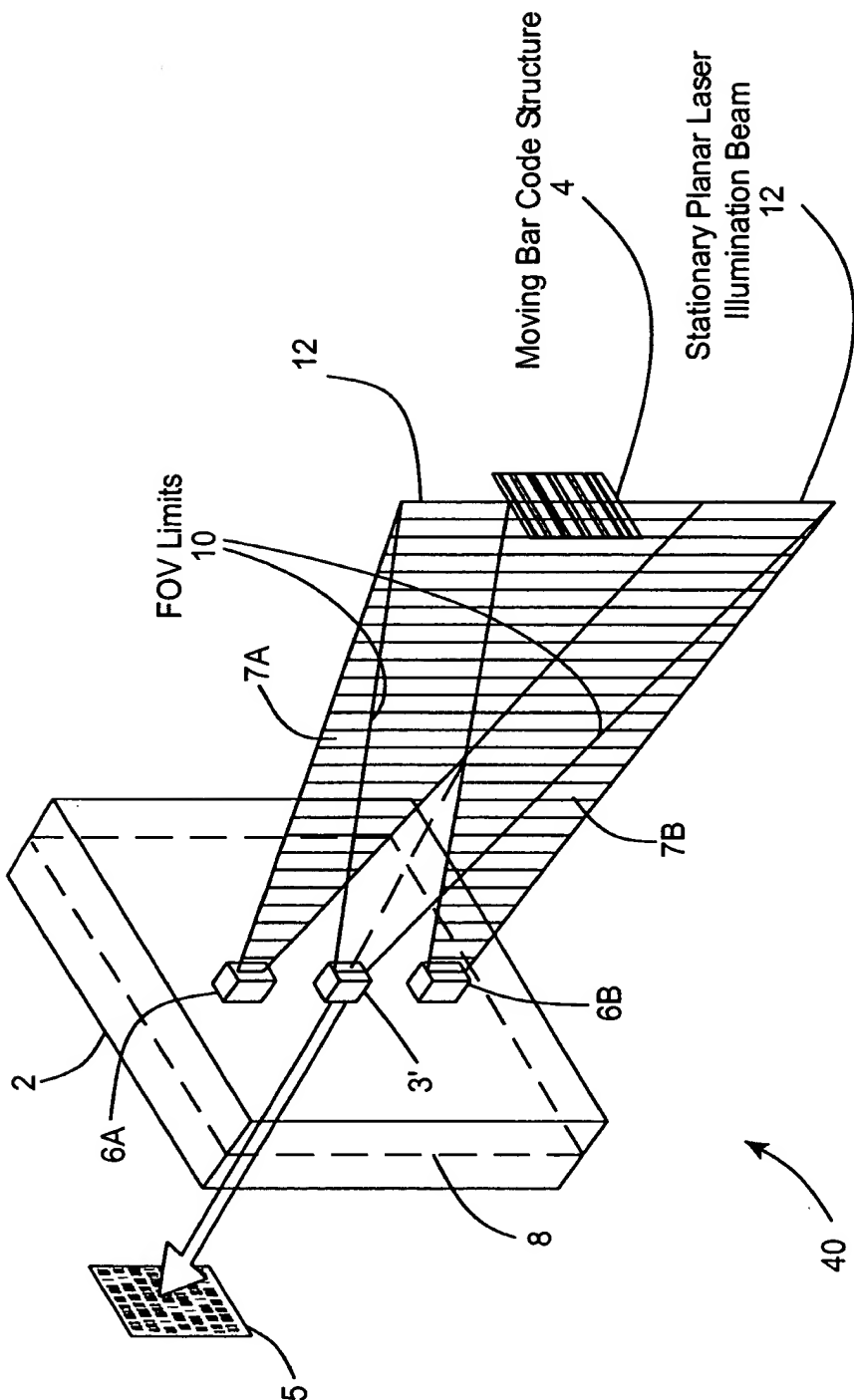


FIG. 2A

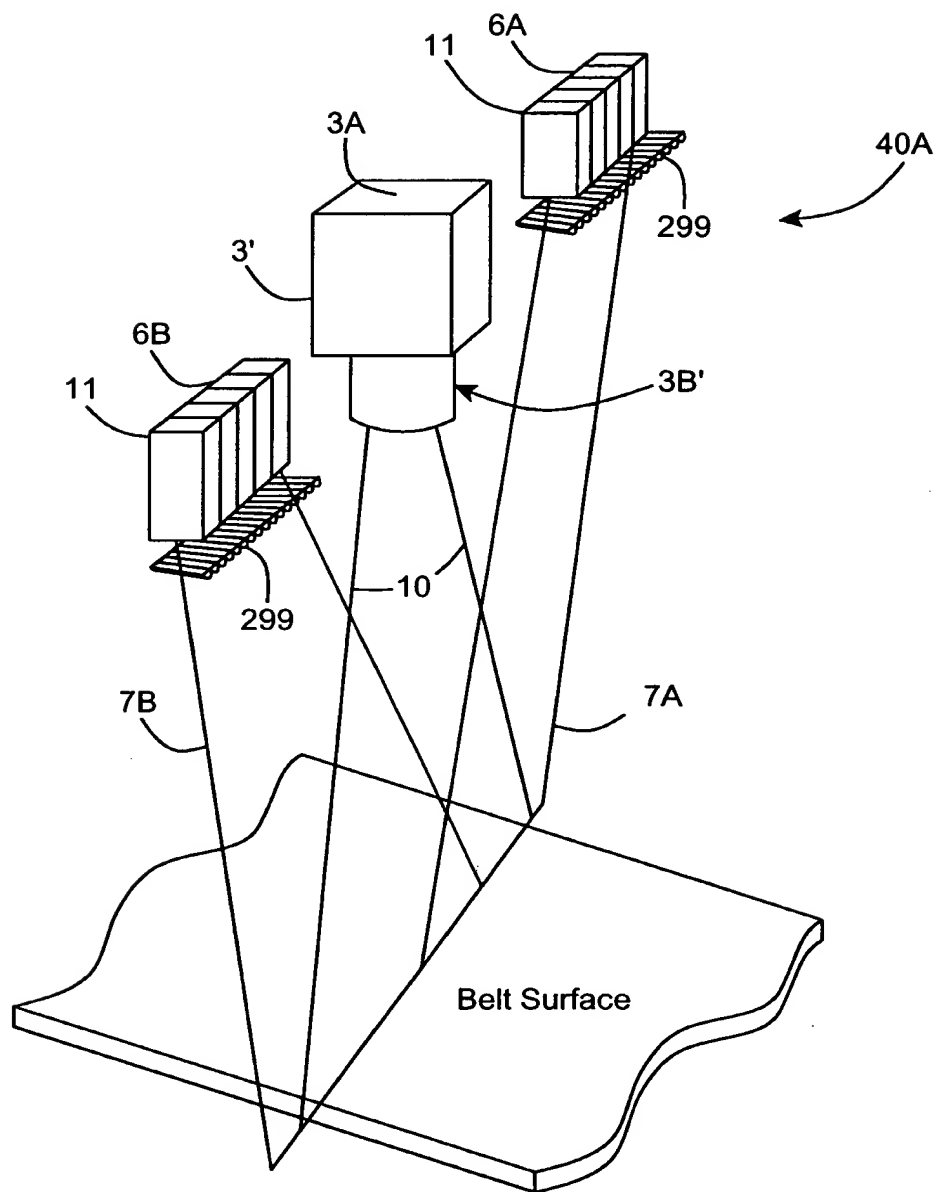


FIG. 2B1

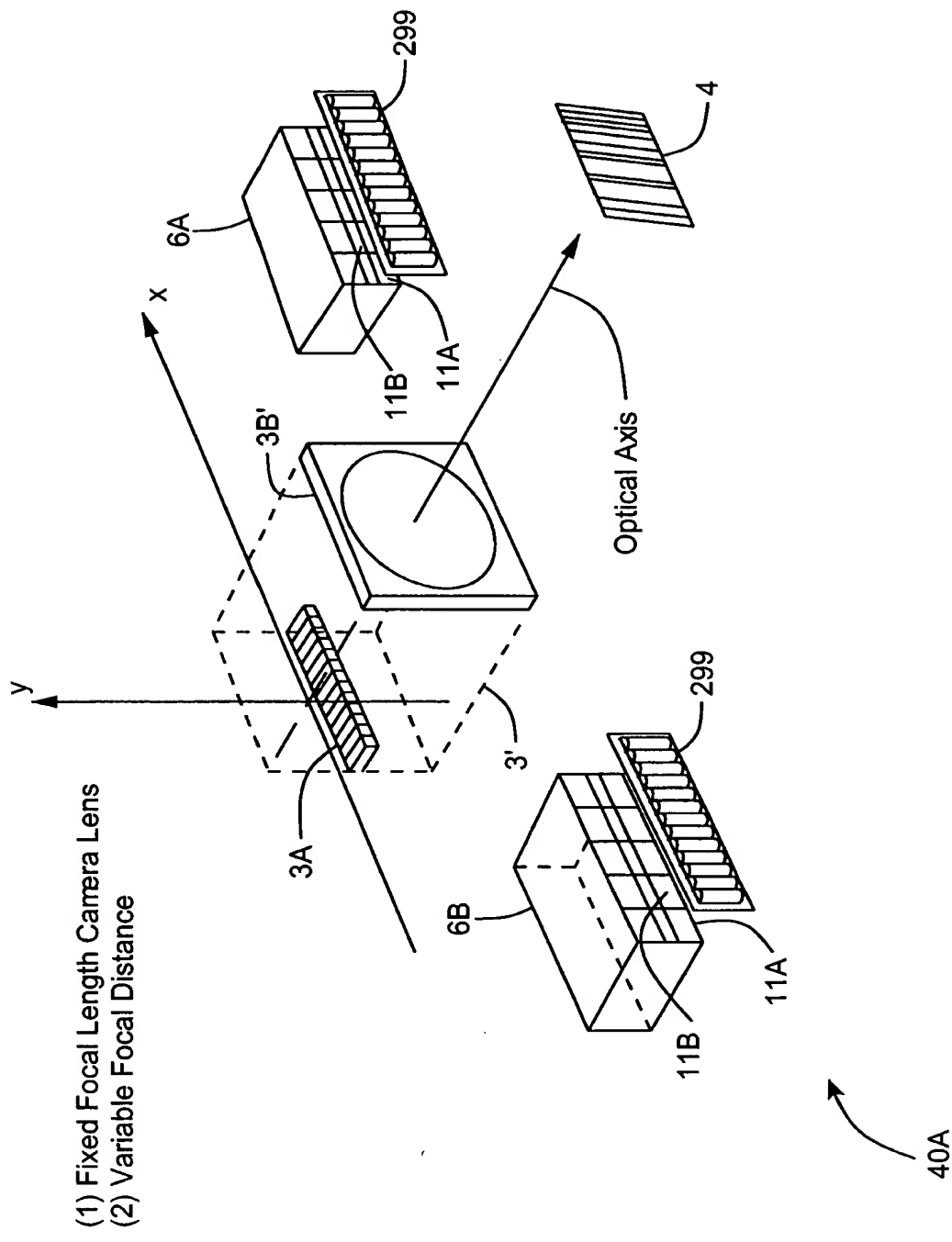


FIG. 2B2

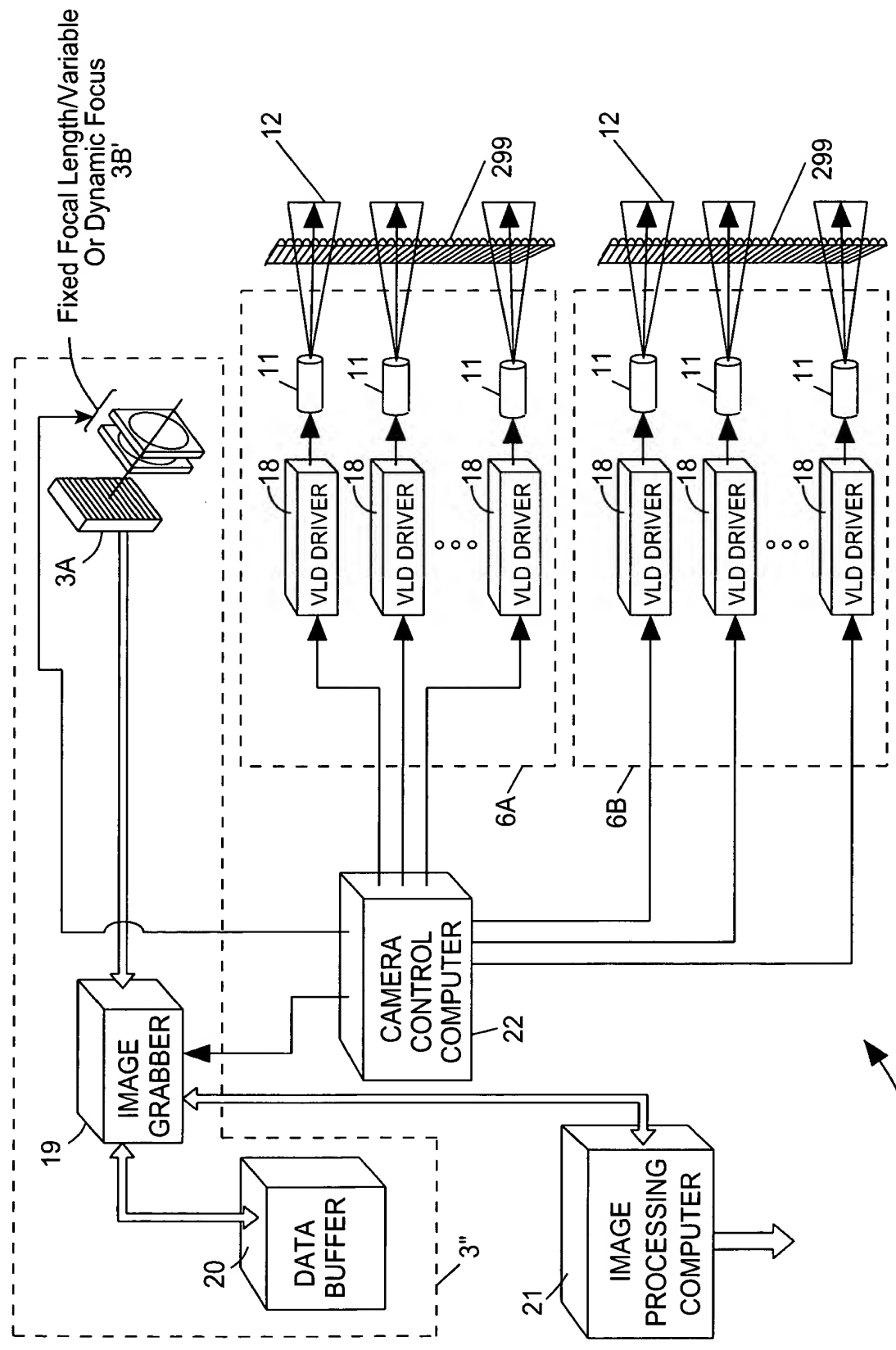
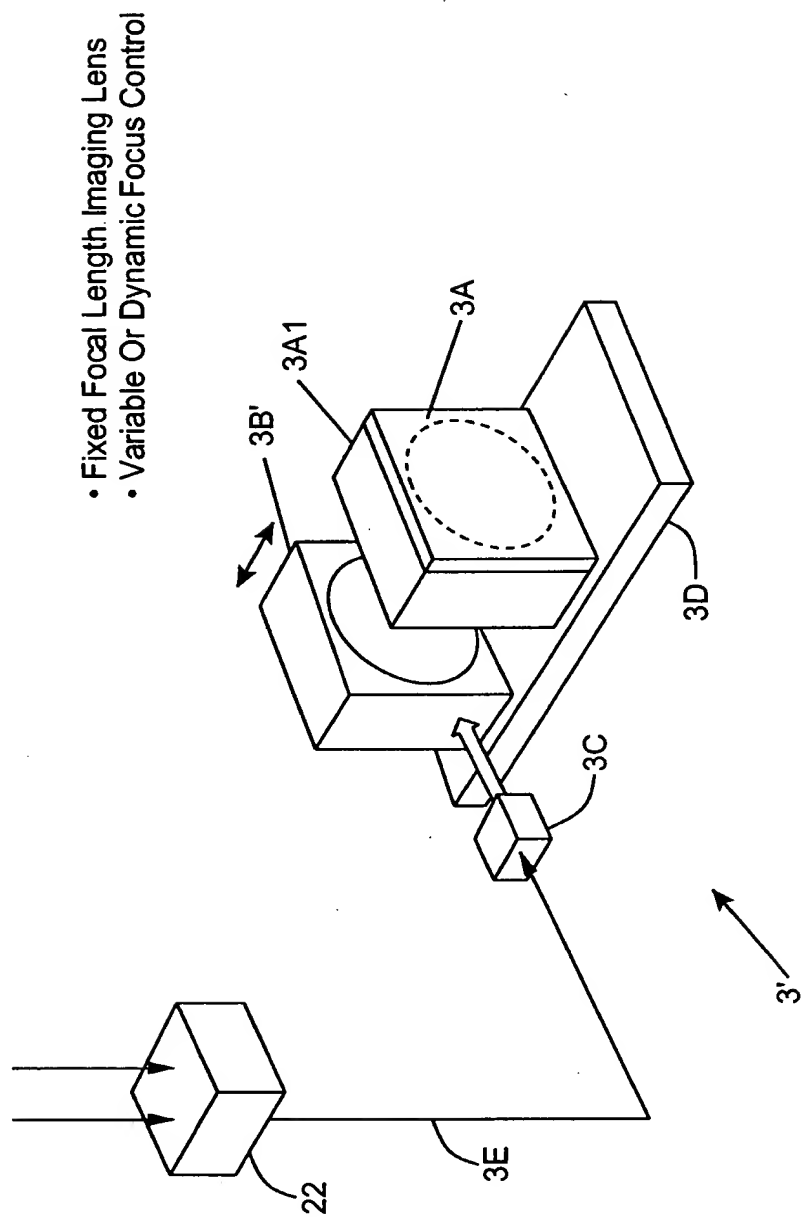


FIG. 2C1

40A



- Fixed Focal Length Imaging Lens
- Variable Or Dynamic Focus Control

FIG. 2C2

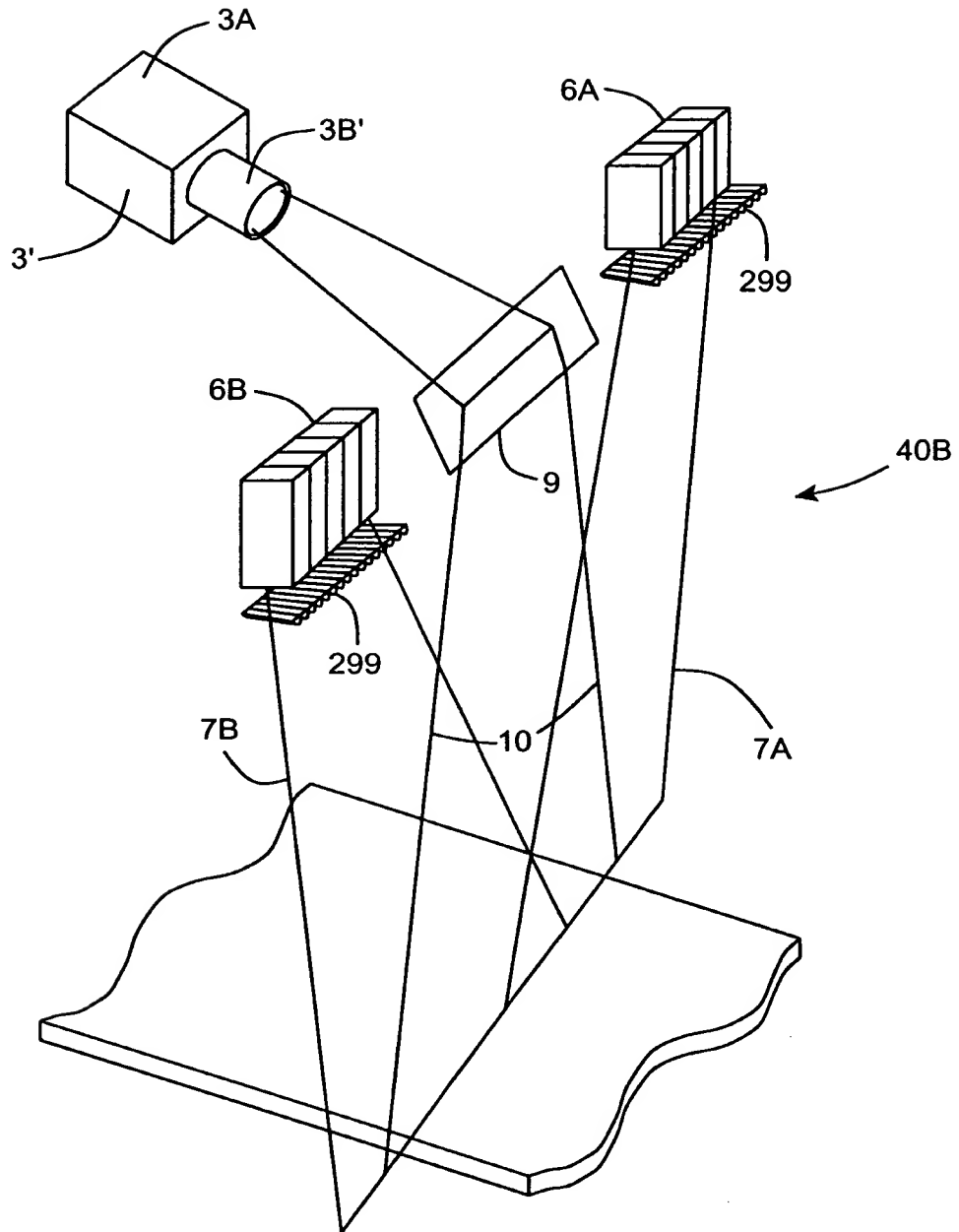
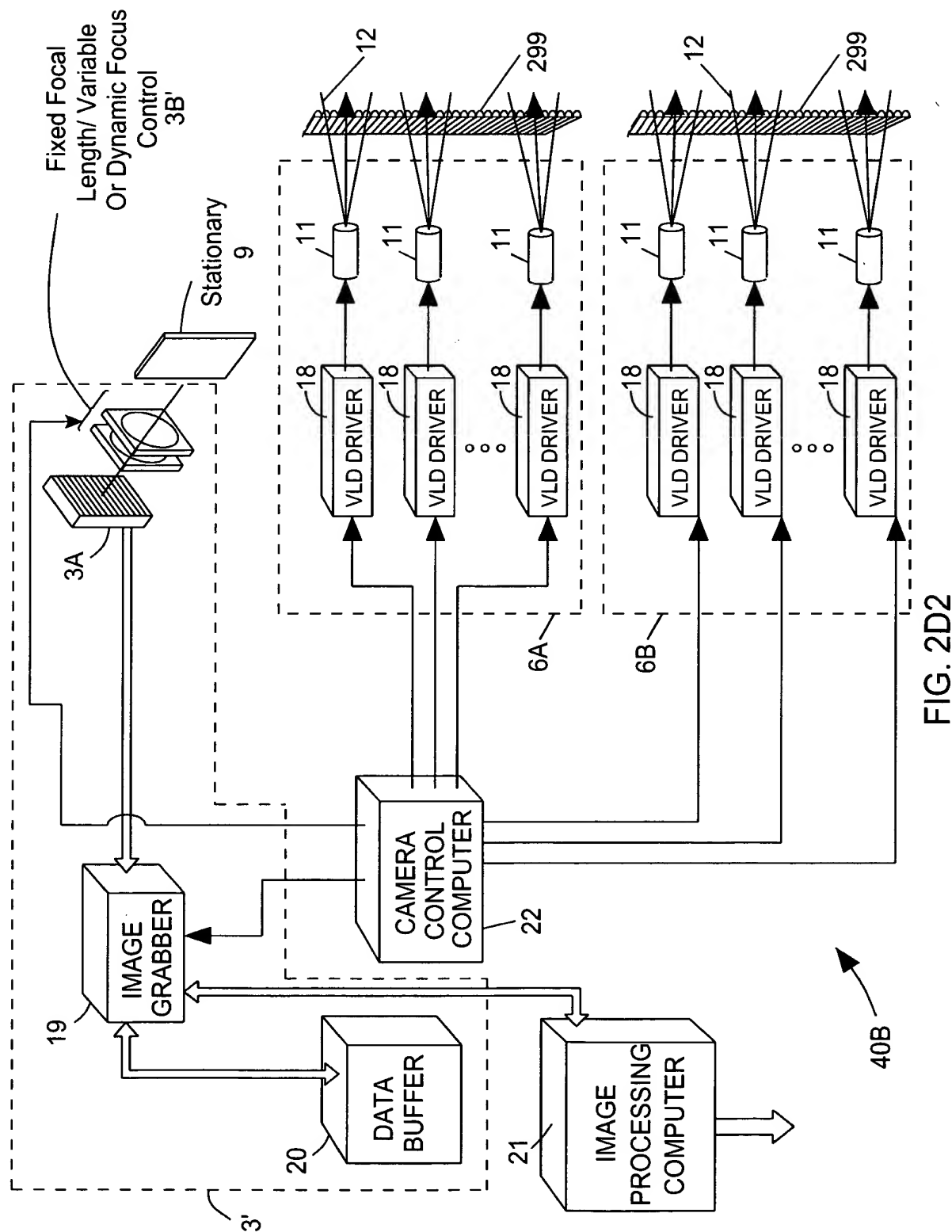
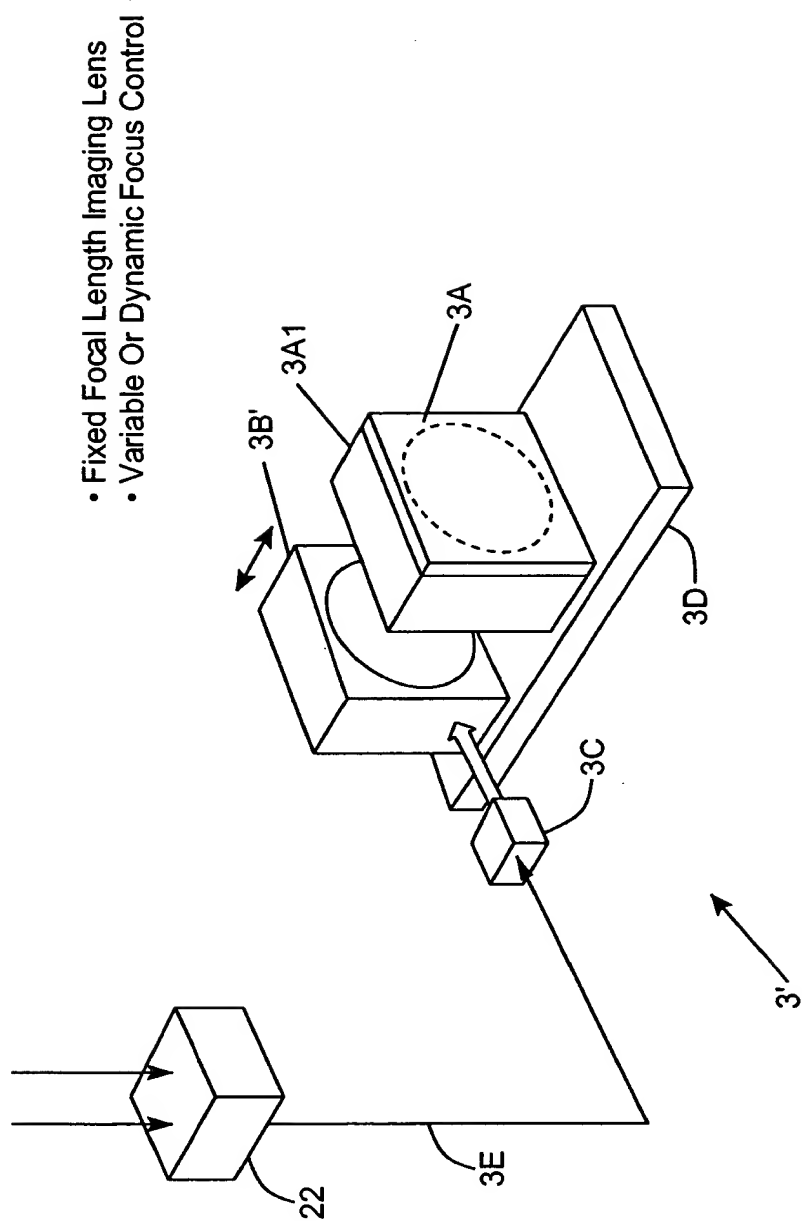


FIG. 2D1





- Fixed Focal Length Imaging Lens
- Variable Or Dynamic Focus Control

FIG. 2D3

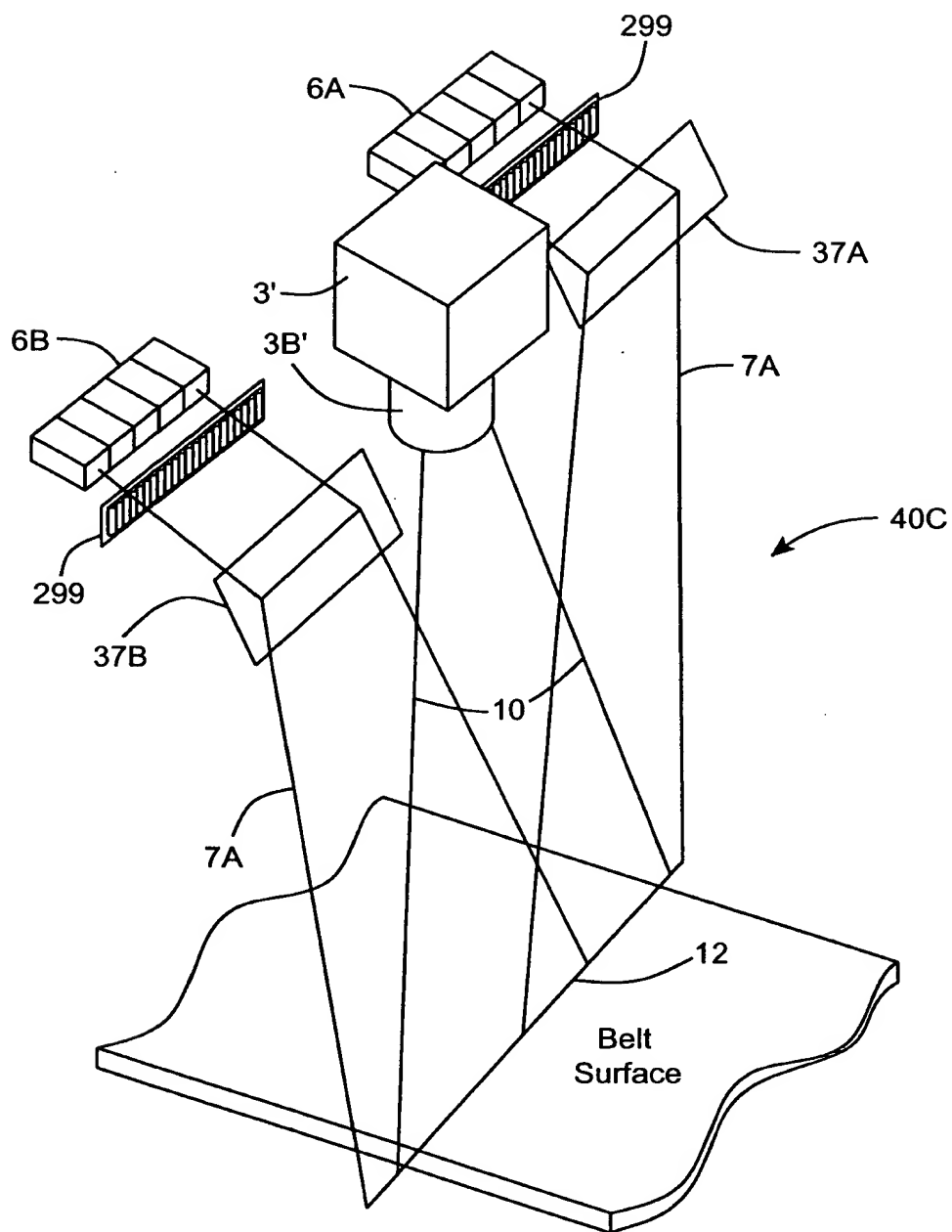


FIG. 2E1

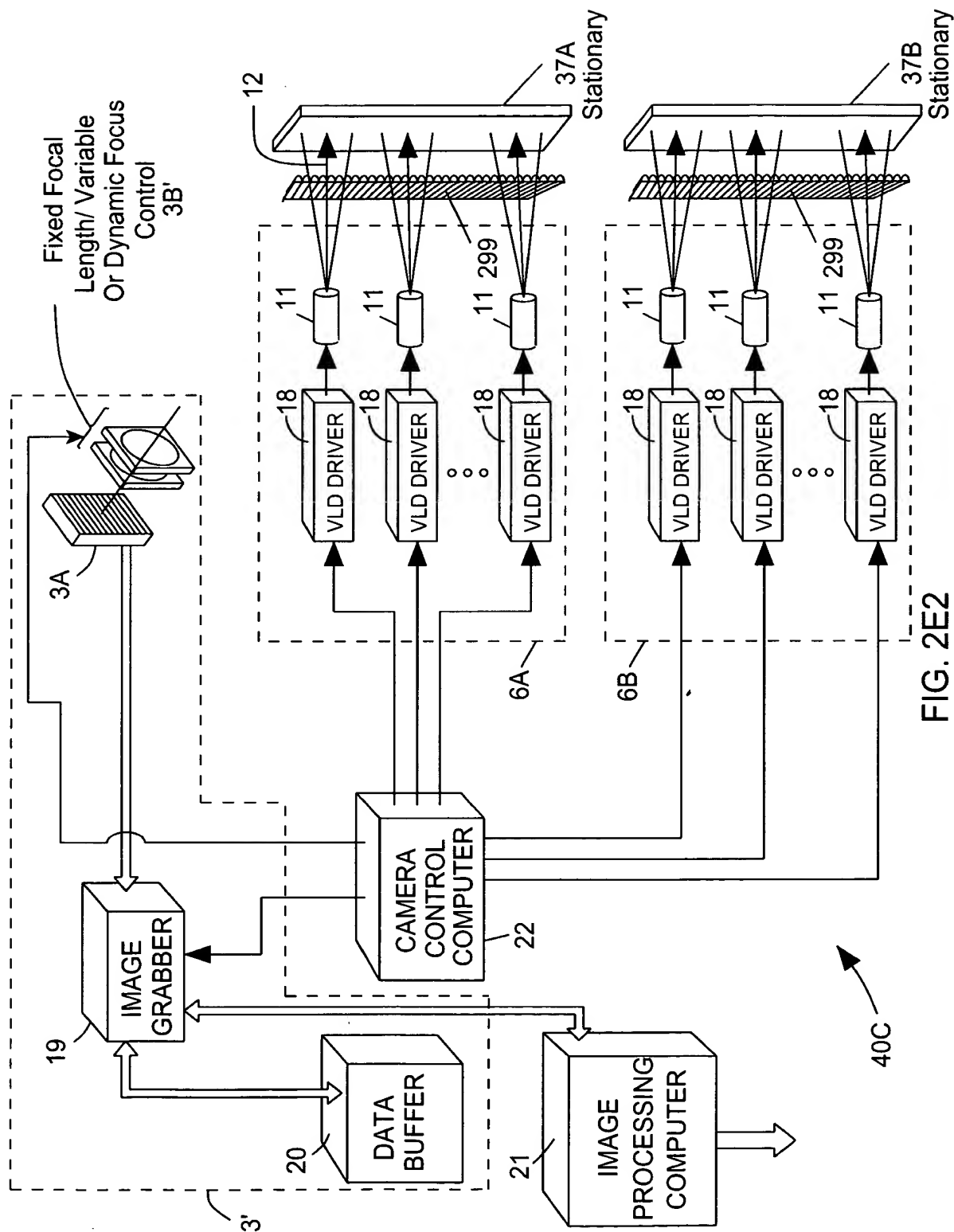


FIG. 2E2

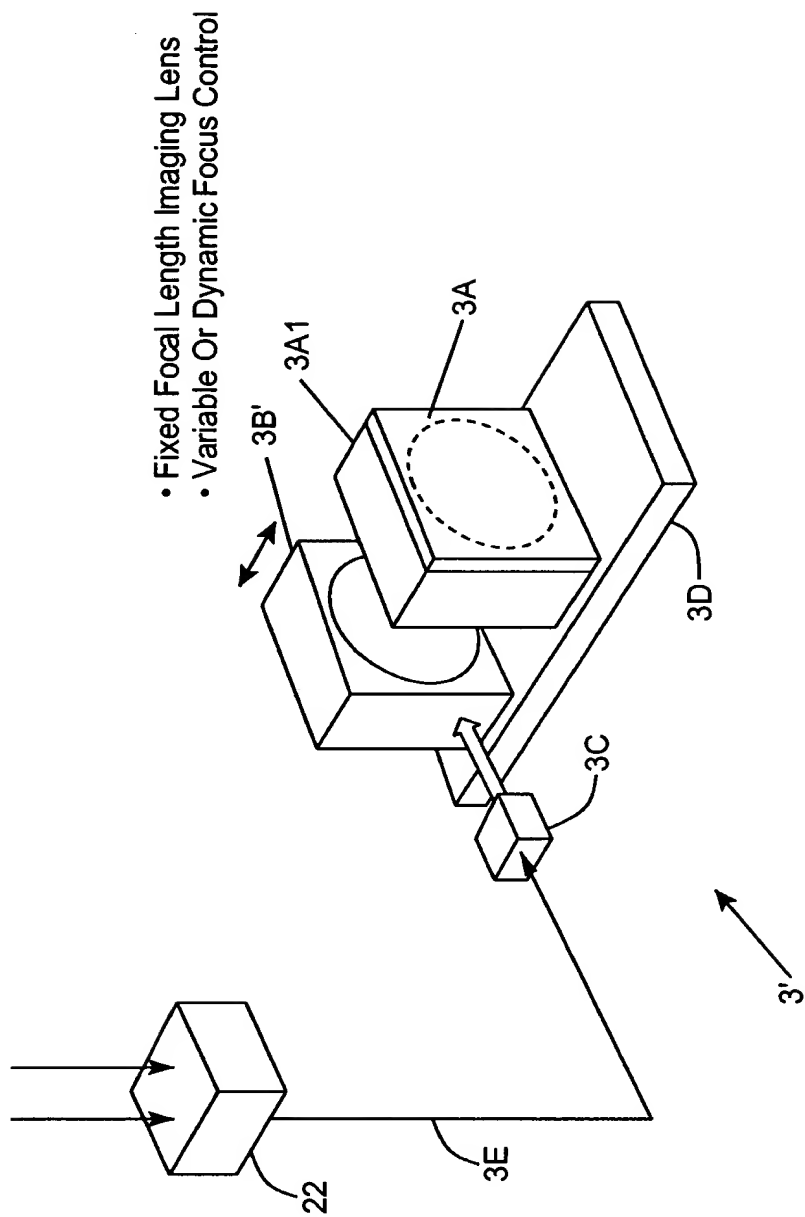


FIG. 2E3

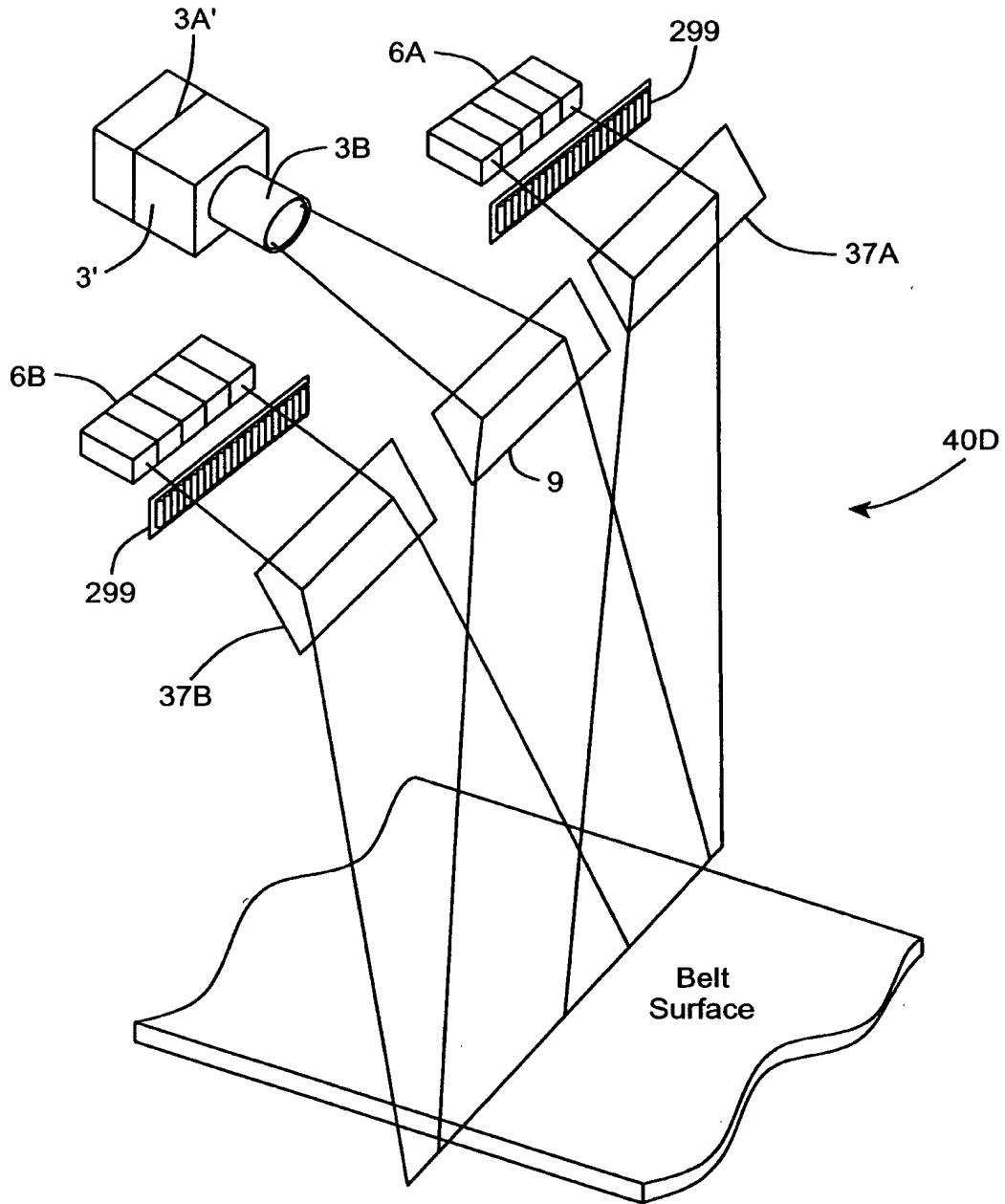


FIG. 2F1

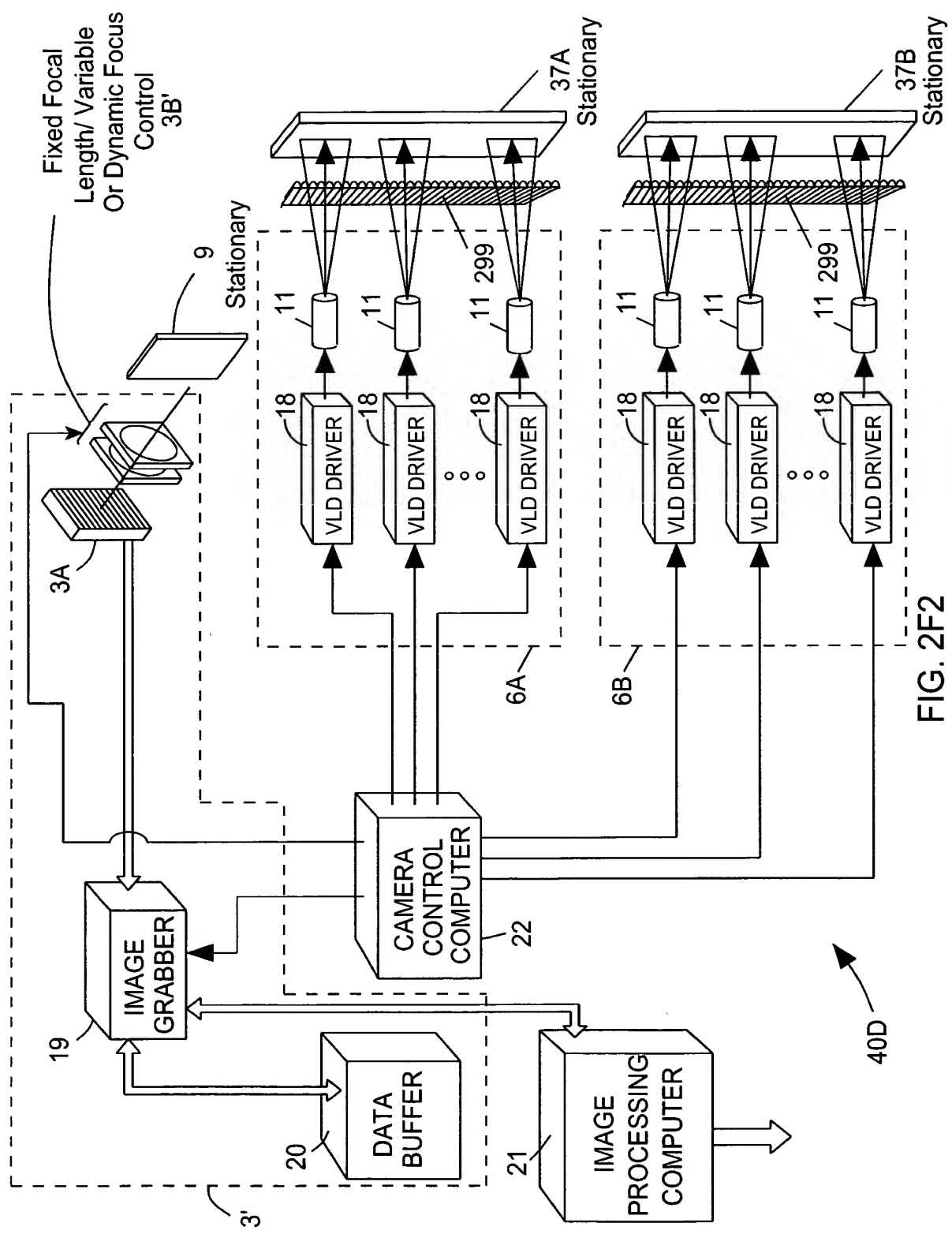
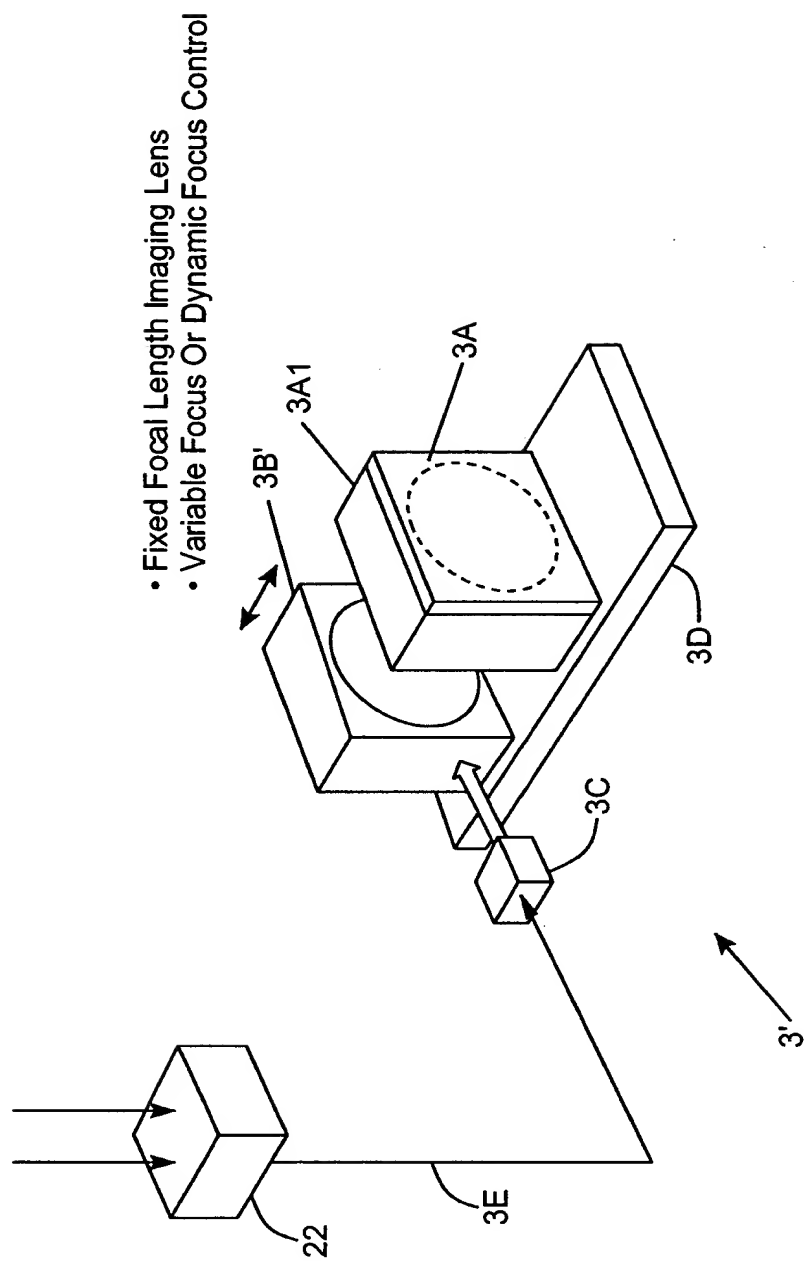


FIG. 2F2



- Fixed Focal Length Imaging Lens
- Variable Focus Or Dynamic Focus Control

FIG. 2F3



Top Conveyor Scanner:

- Fixed Focal Length Imaging Lens
- Variable Focal Distance Control

Side Conveyor Scanner:

- Fixed Focal Length Imaging Lens
- Dynamic Focal Distance Control

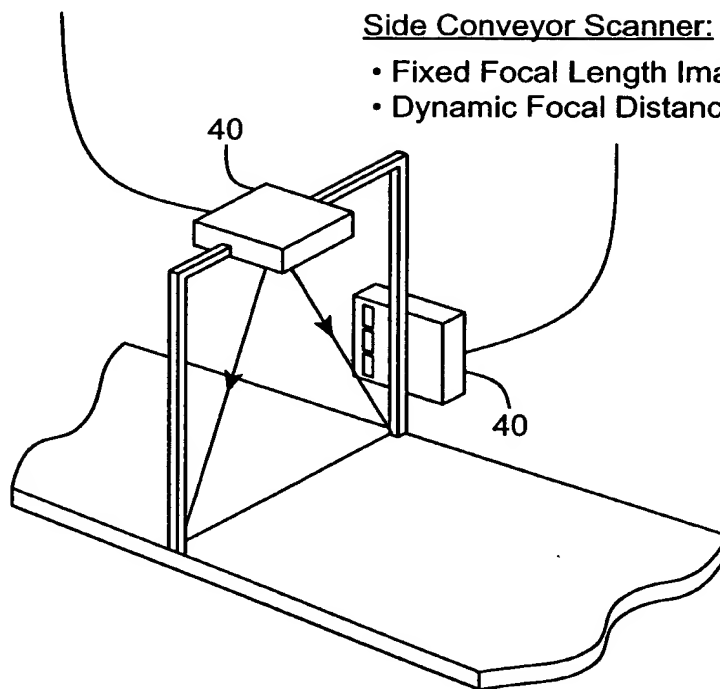


FIG. 2G

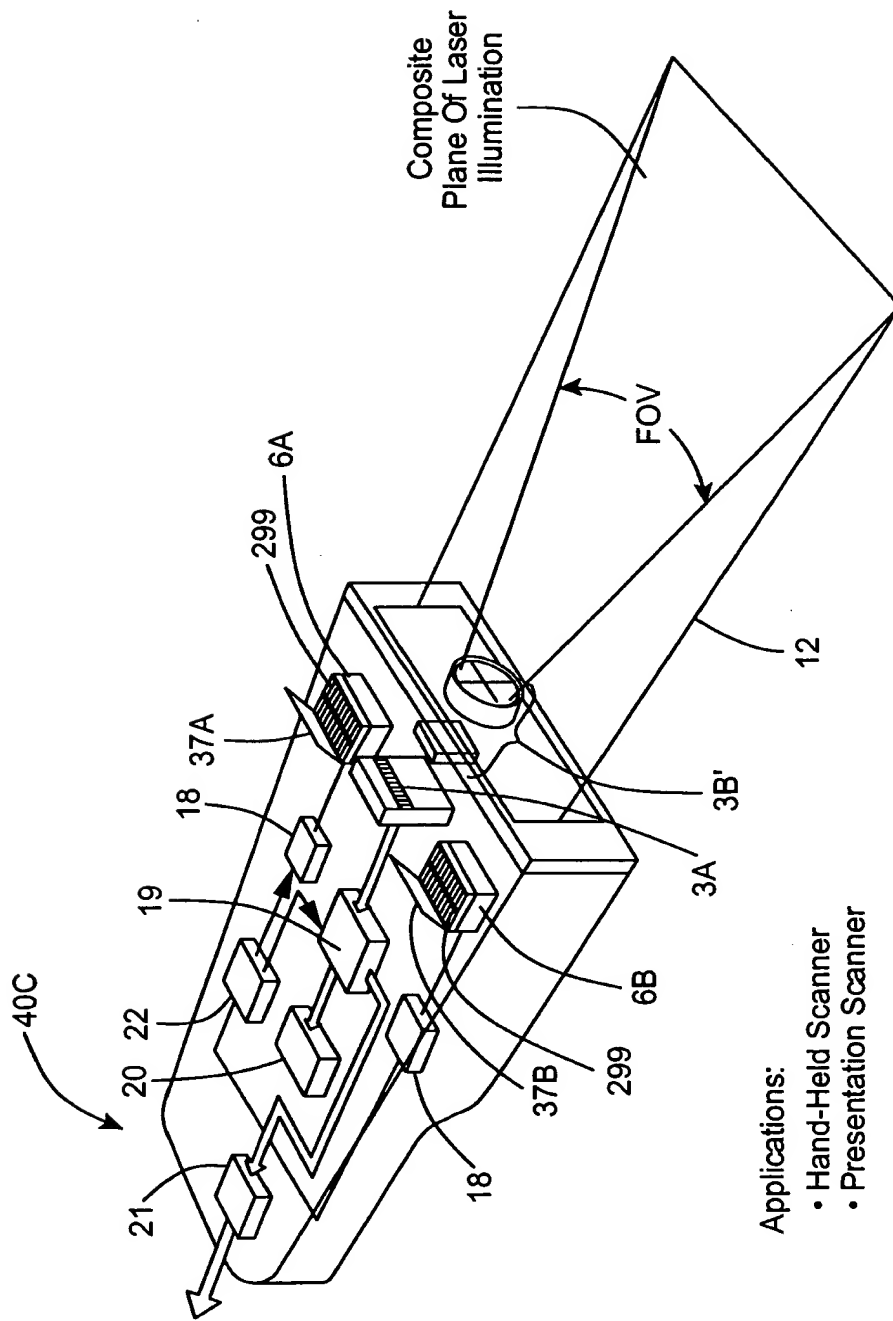
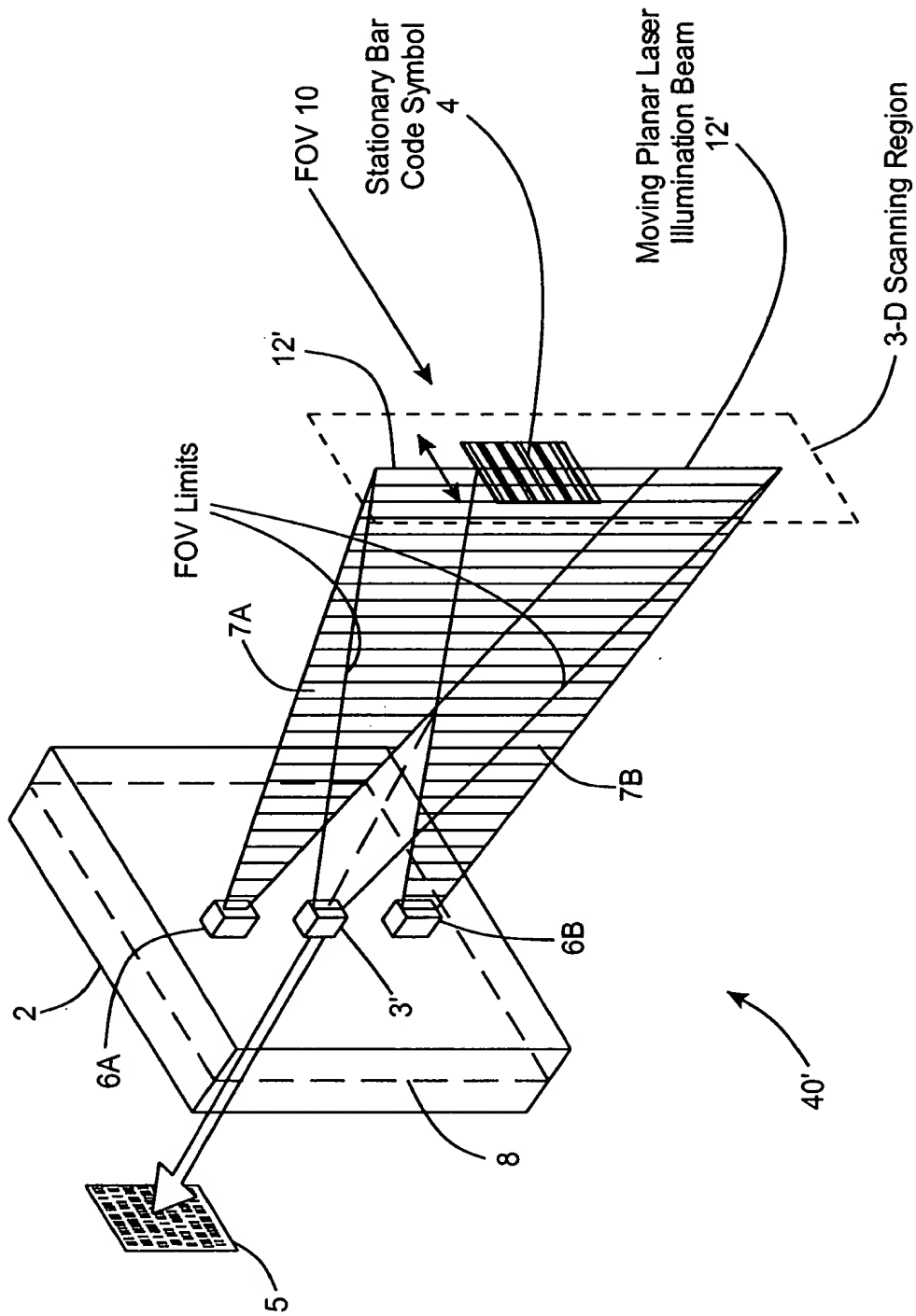


FIG. 2H

- Applications:
- Hand-Held Scanner
 - Presentation Scanner



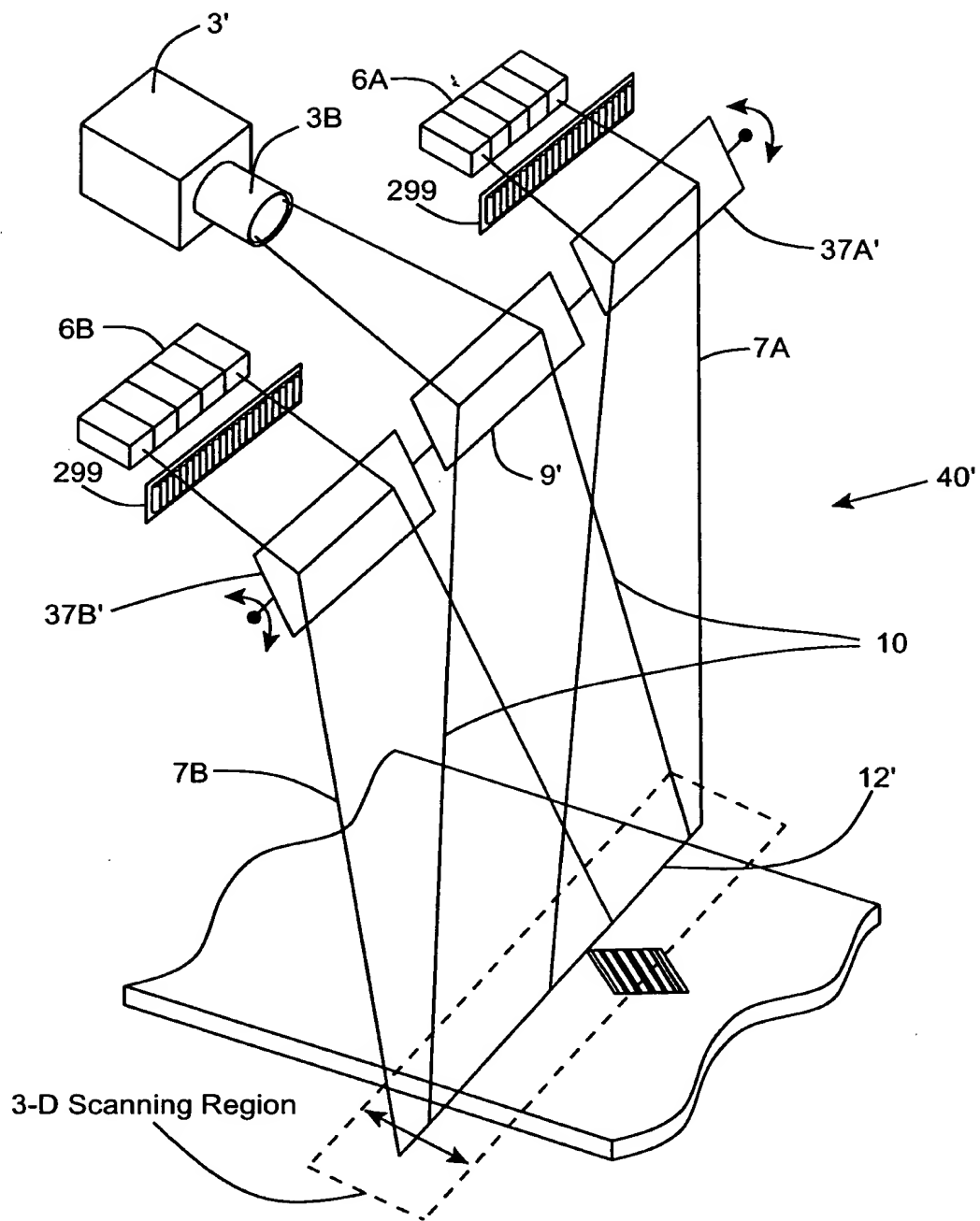


FIG. 212

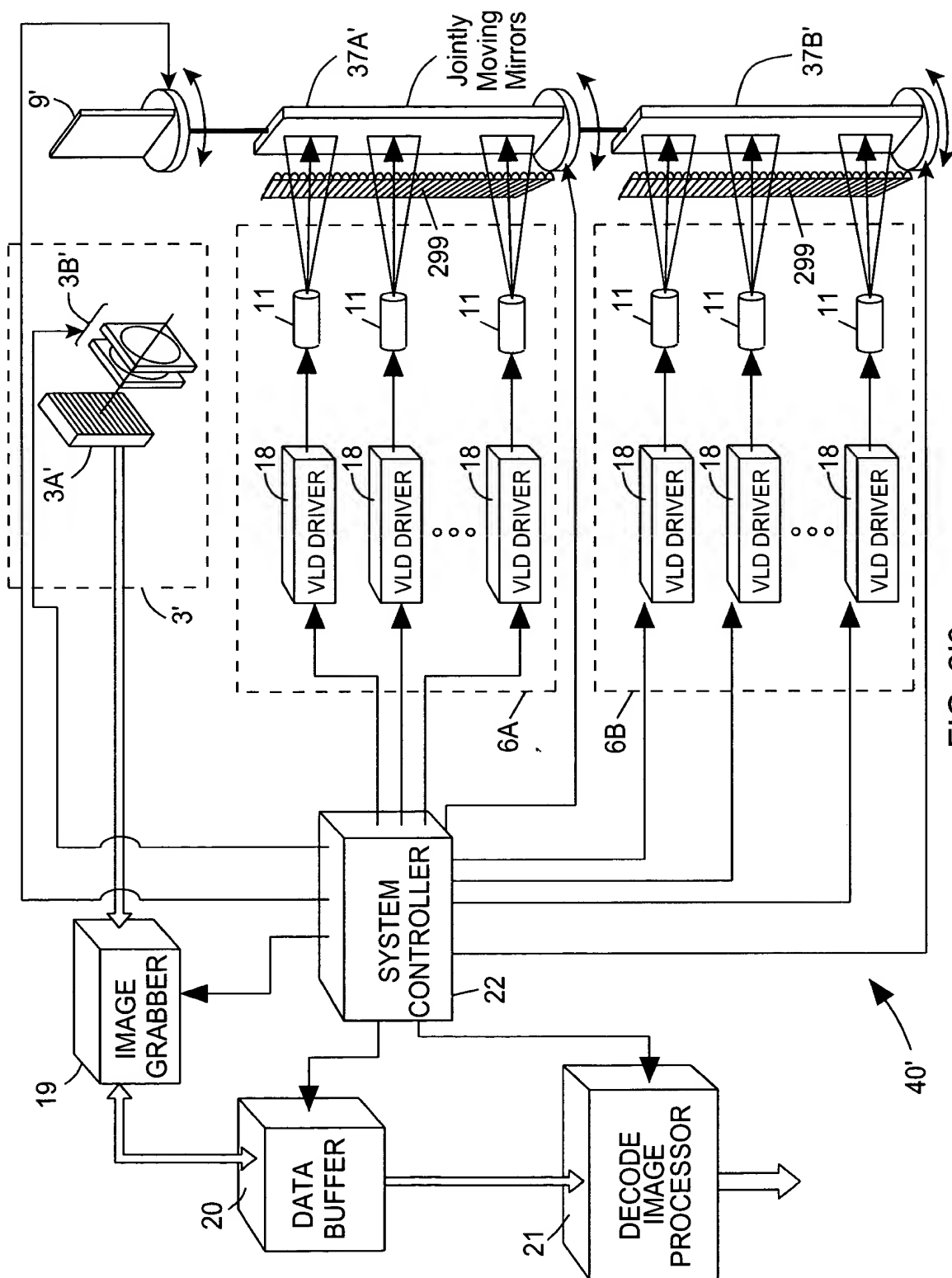


FIG. 213

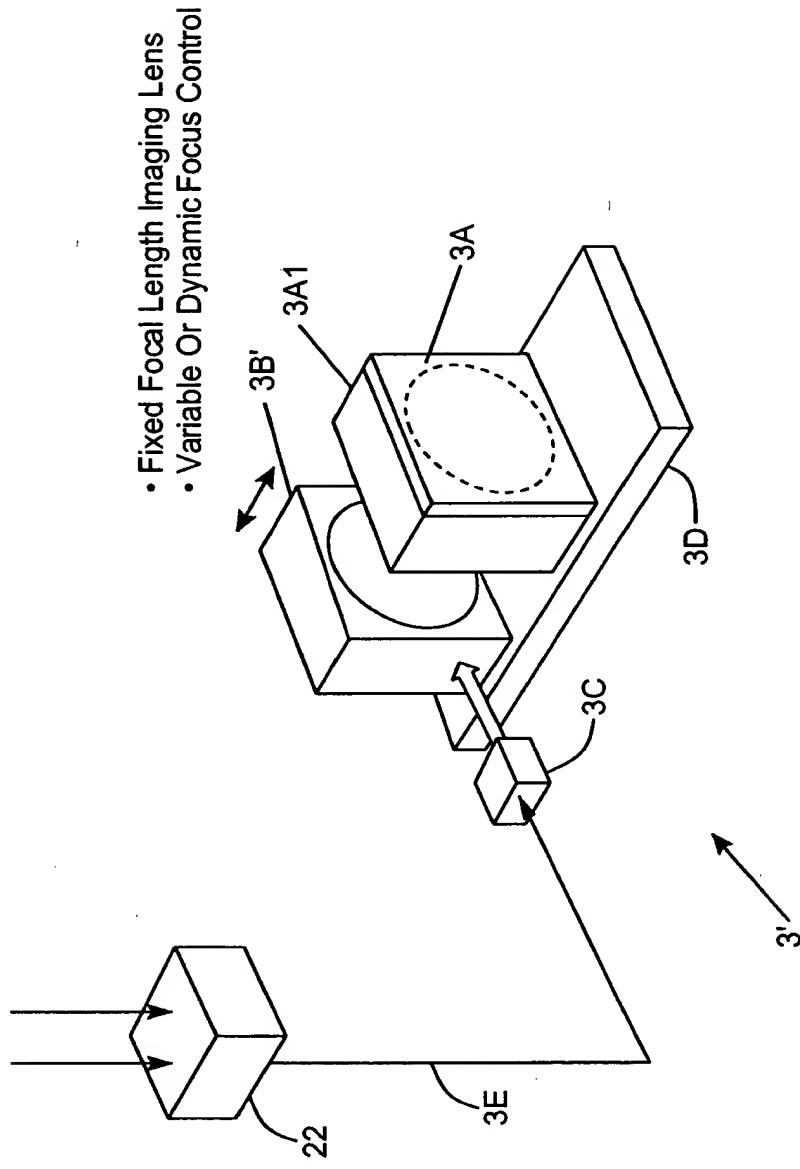


FIG. 2I4

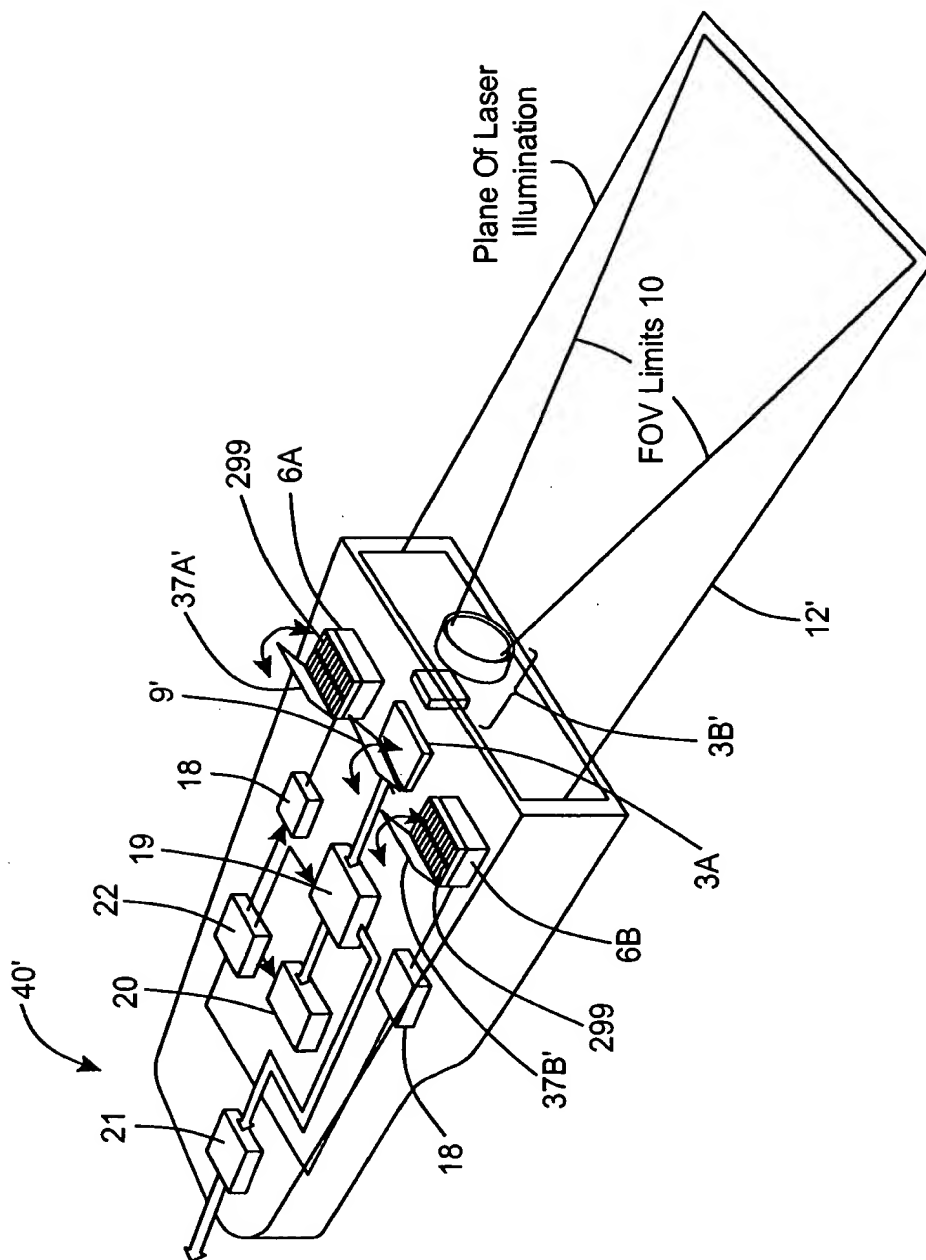


FIG. 215

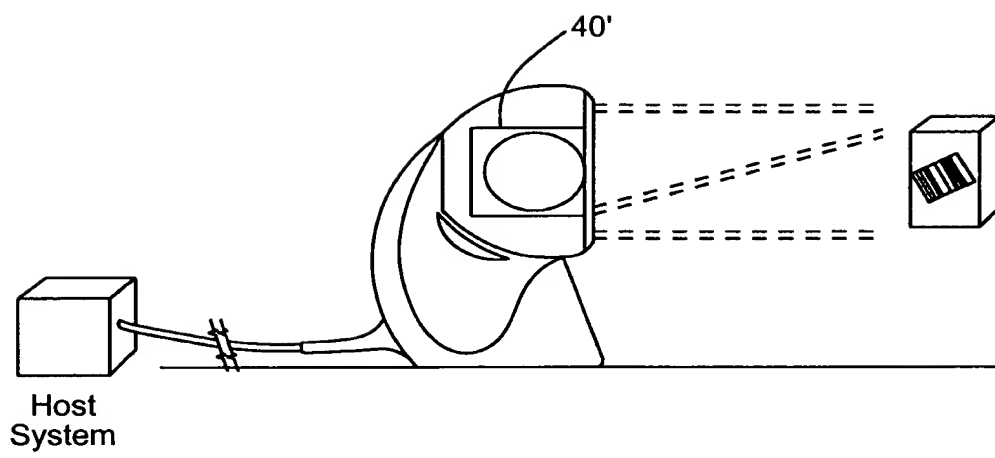


FIG. 216

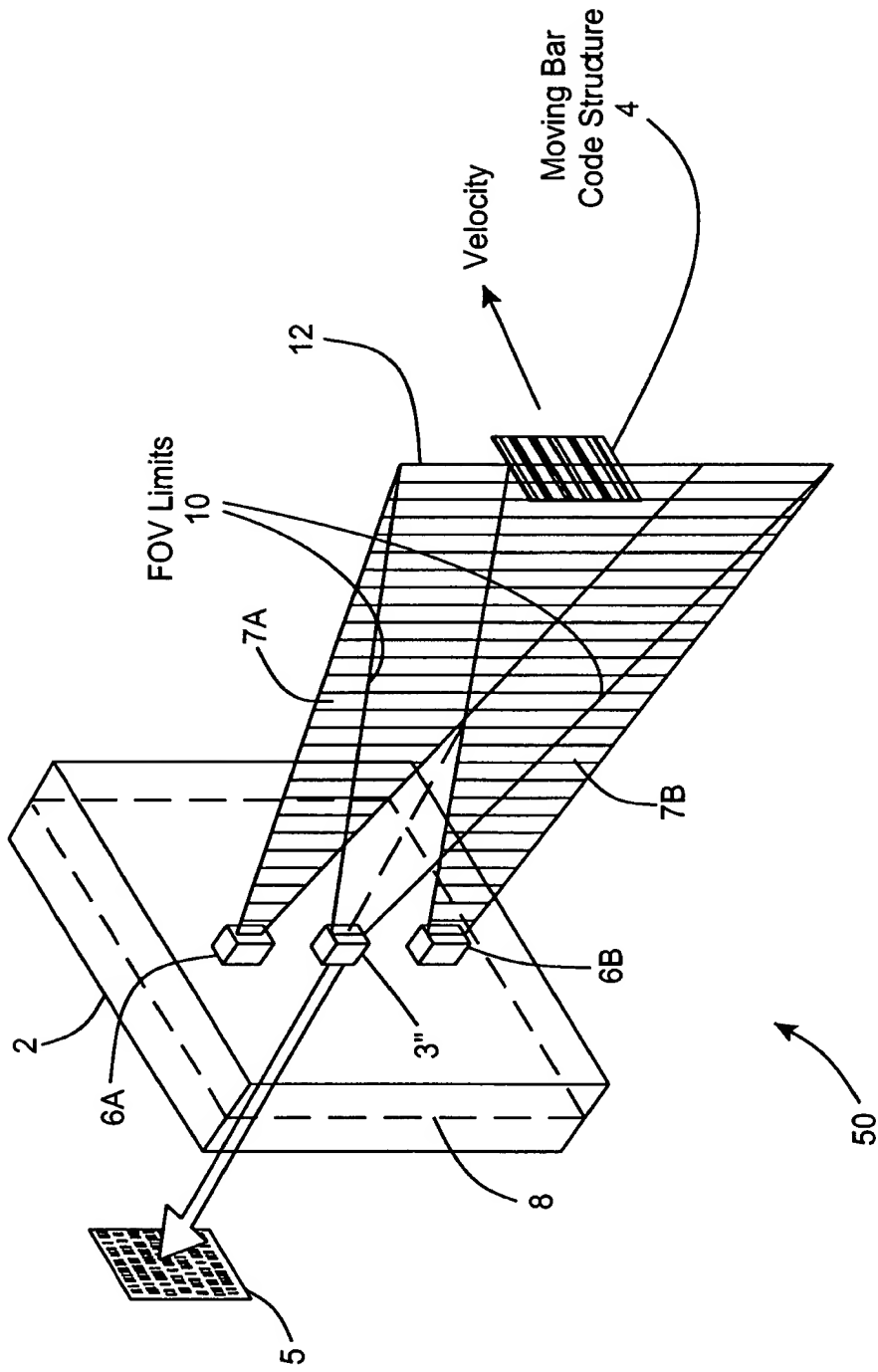


FIG. 3A

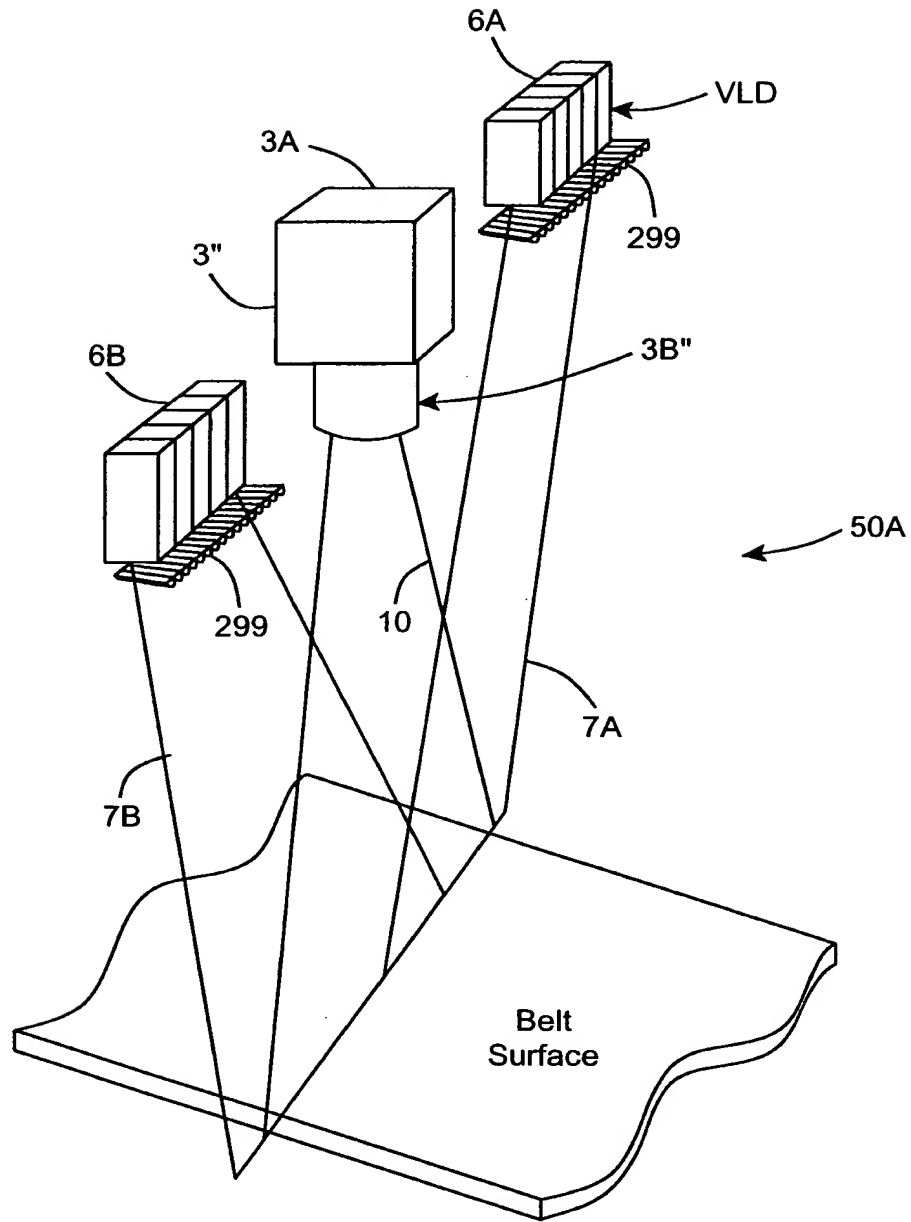


FIG. 3B1

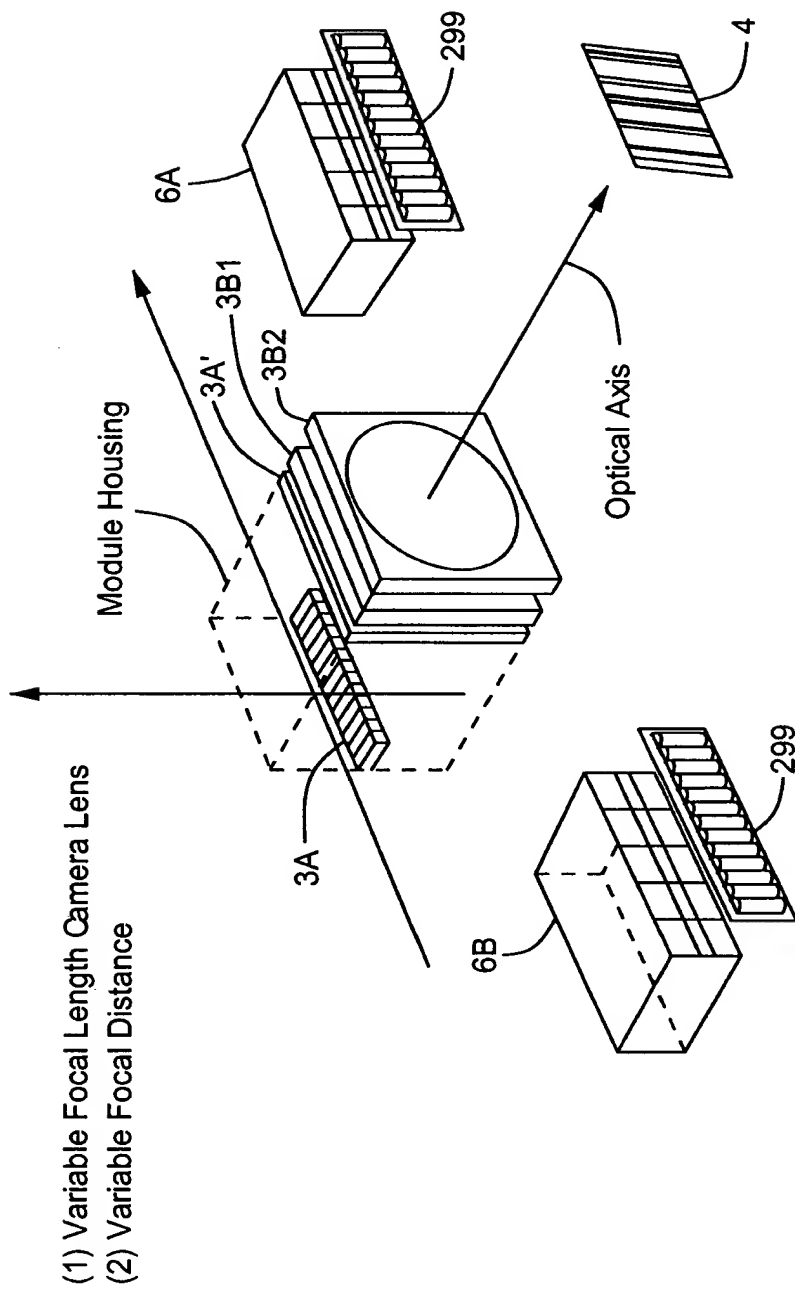


FIG. 3B2

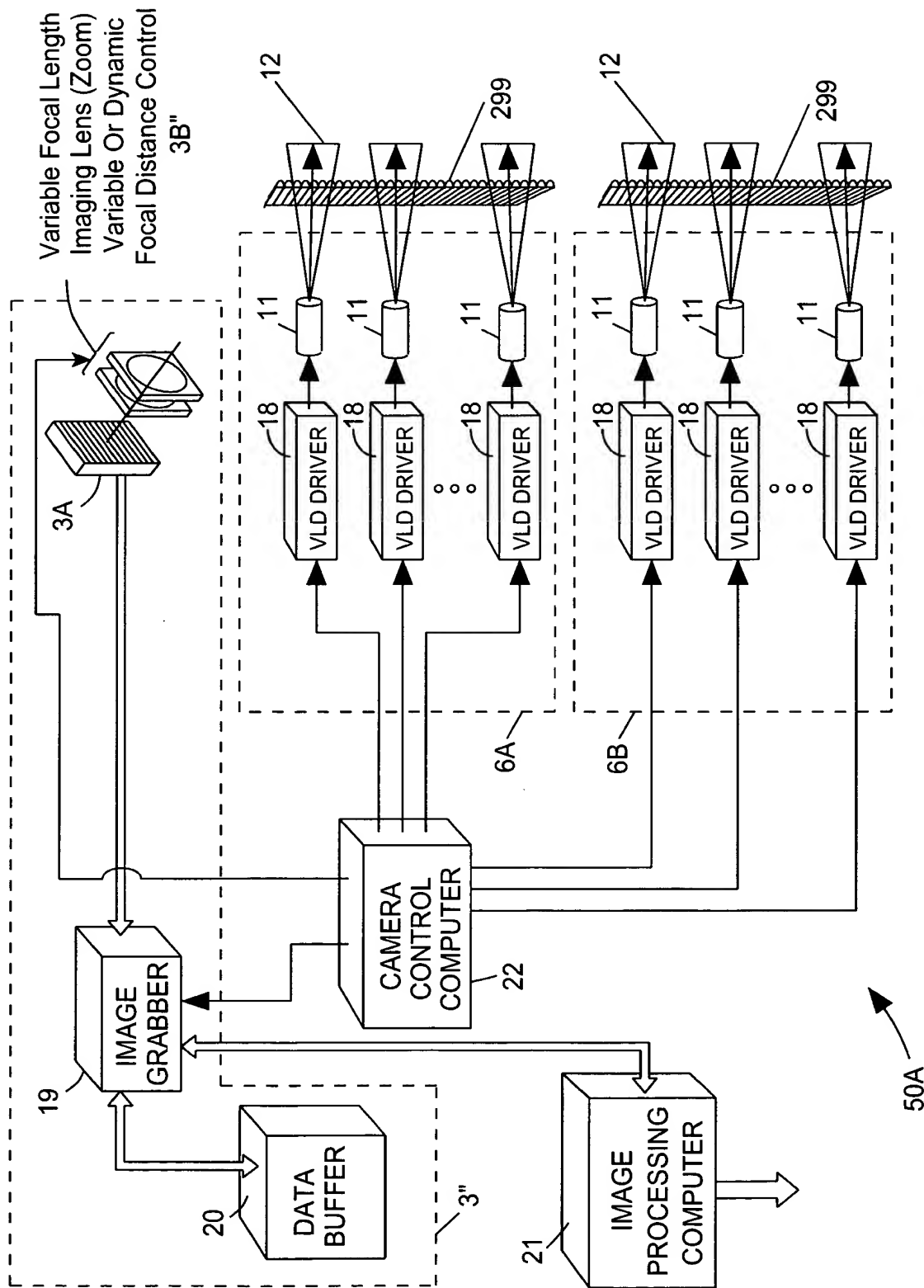


FIG. 3C1

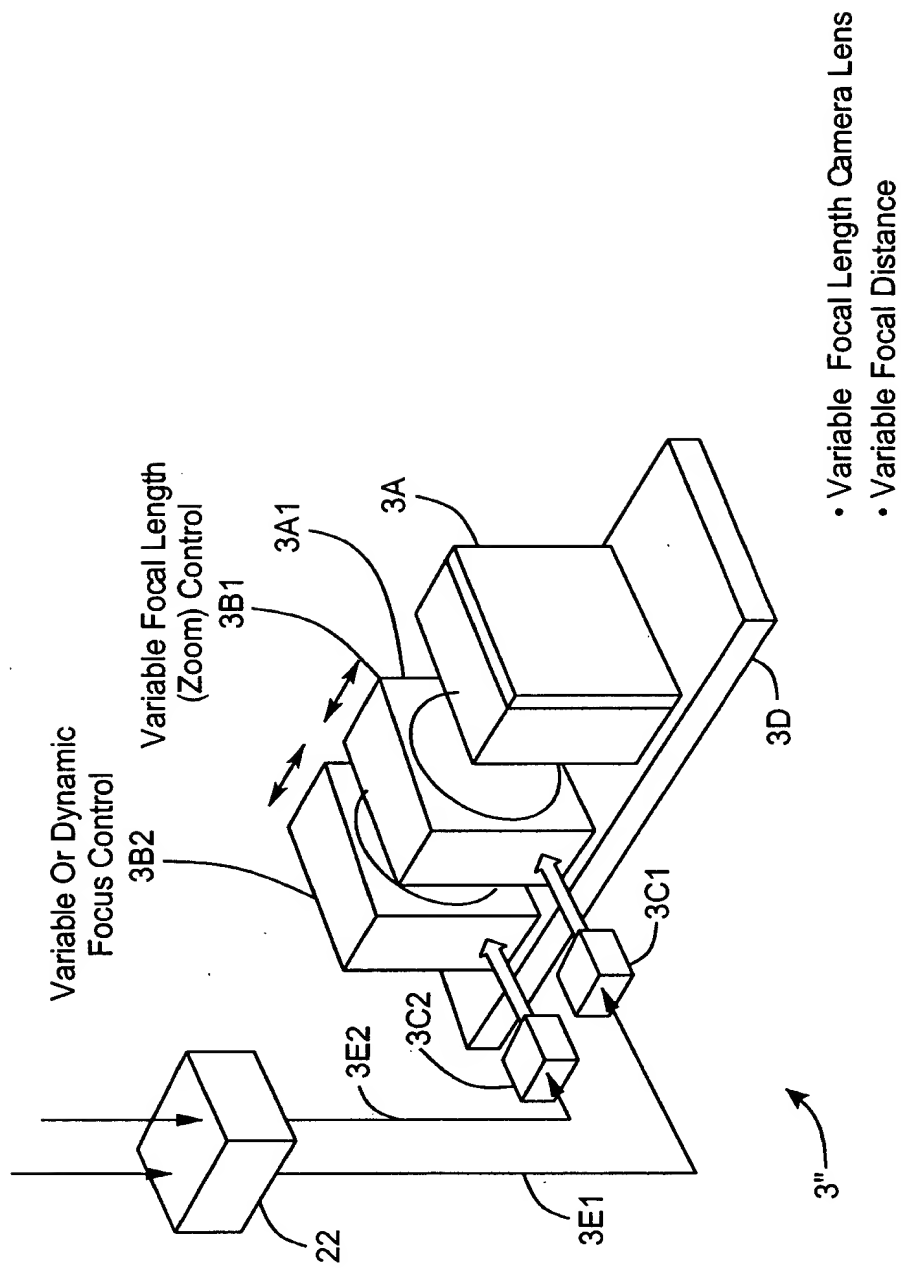


FIG. 3C2

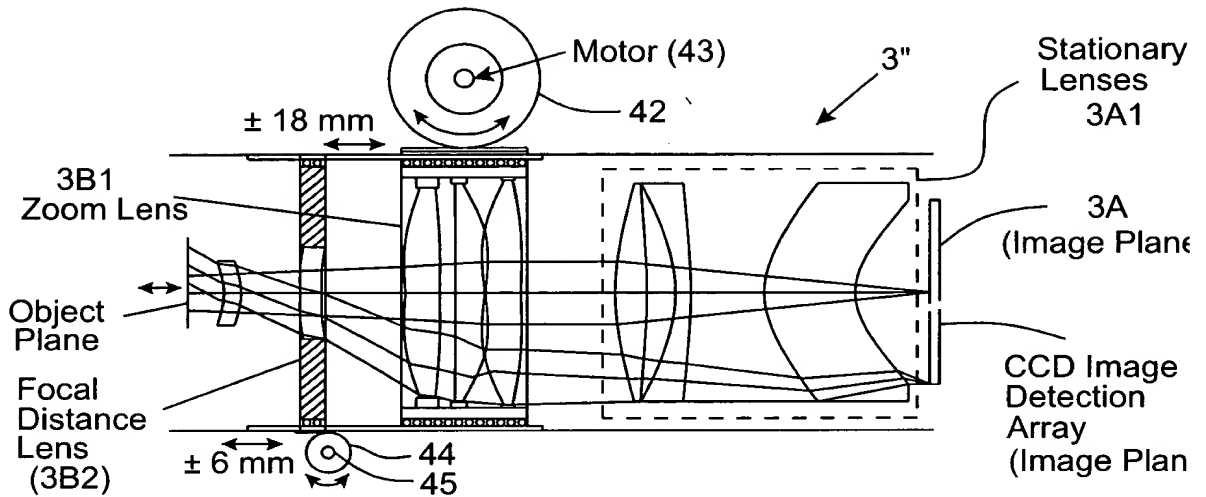


FIG. 3D1

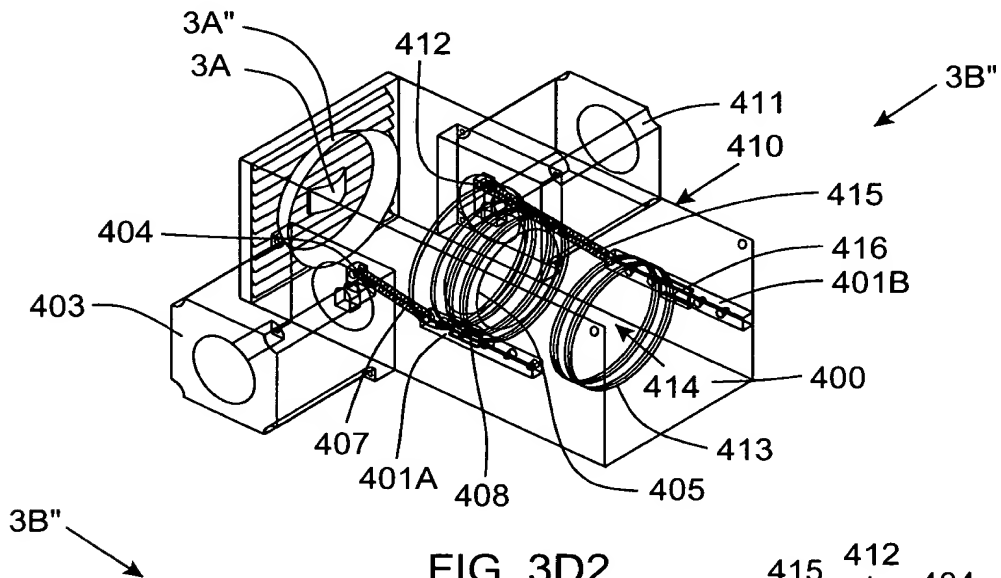


FIG. 3D2

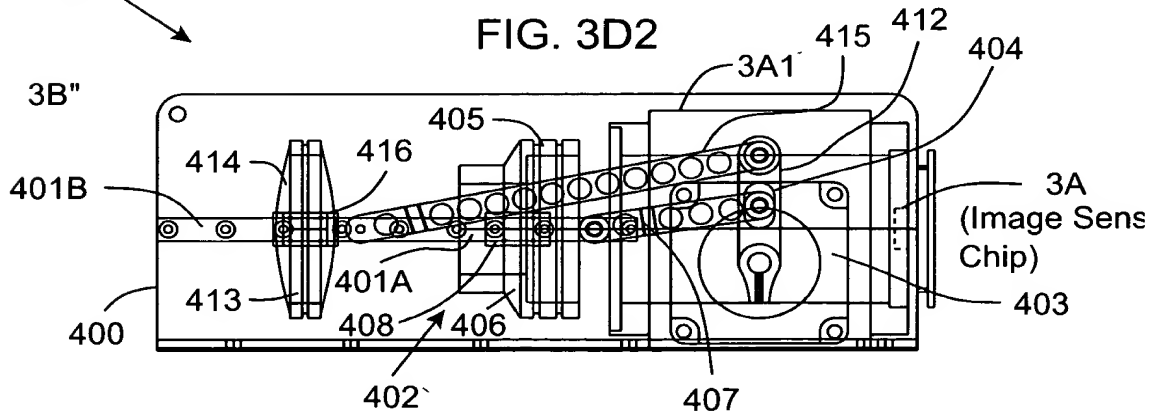


FIG. 3D3

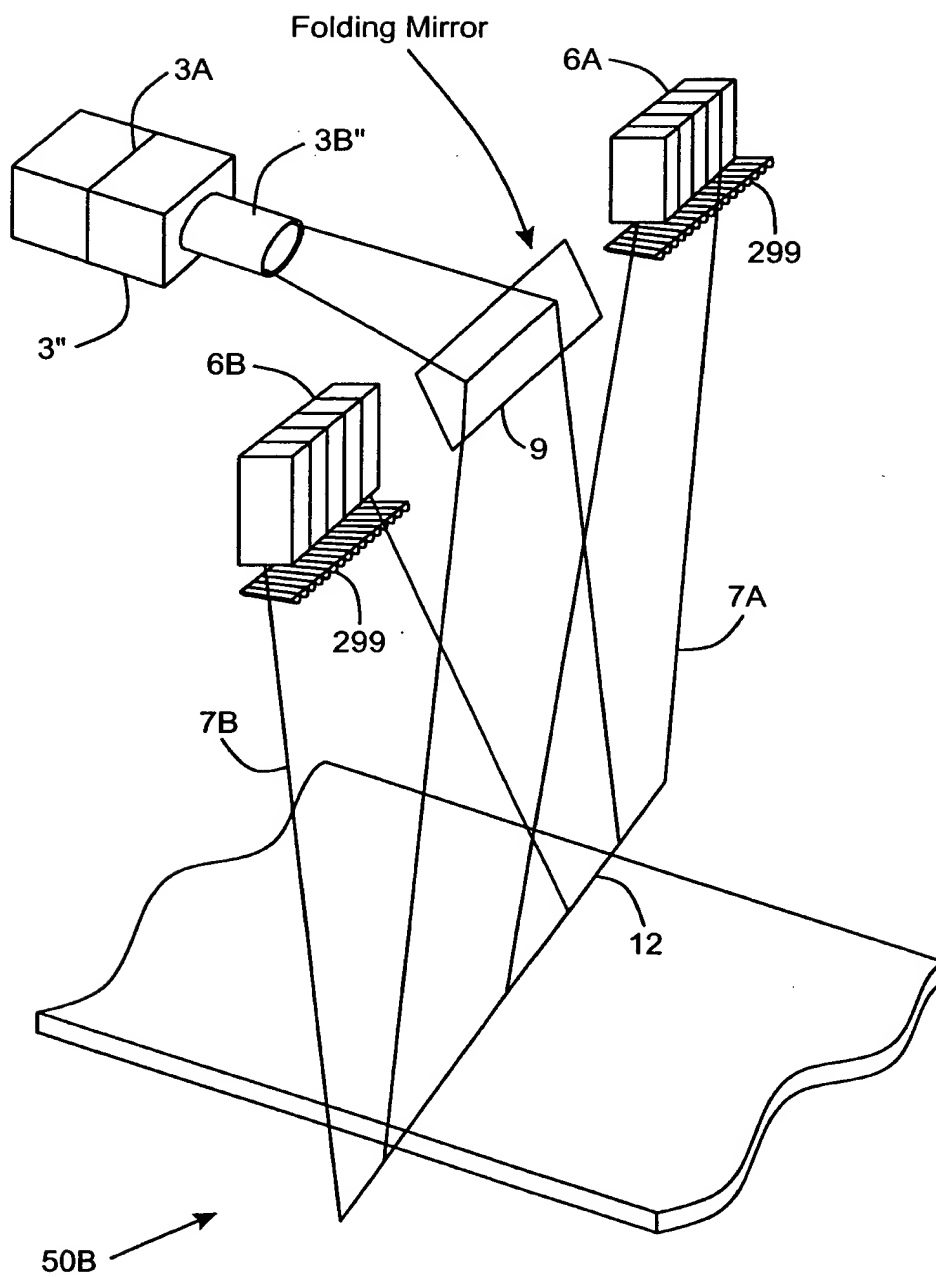


FIG. 3E1

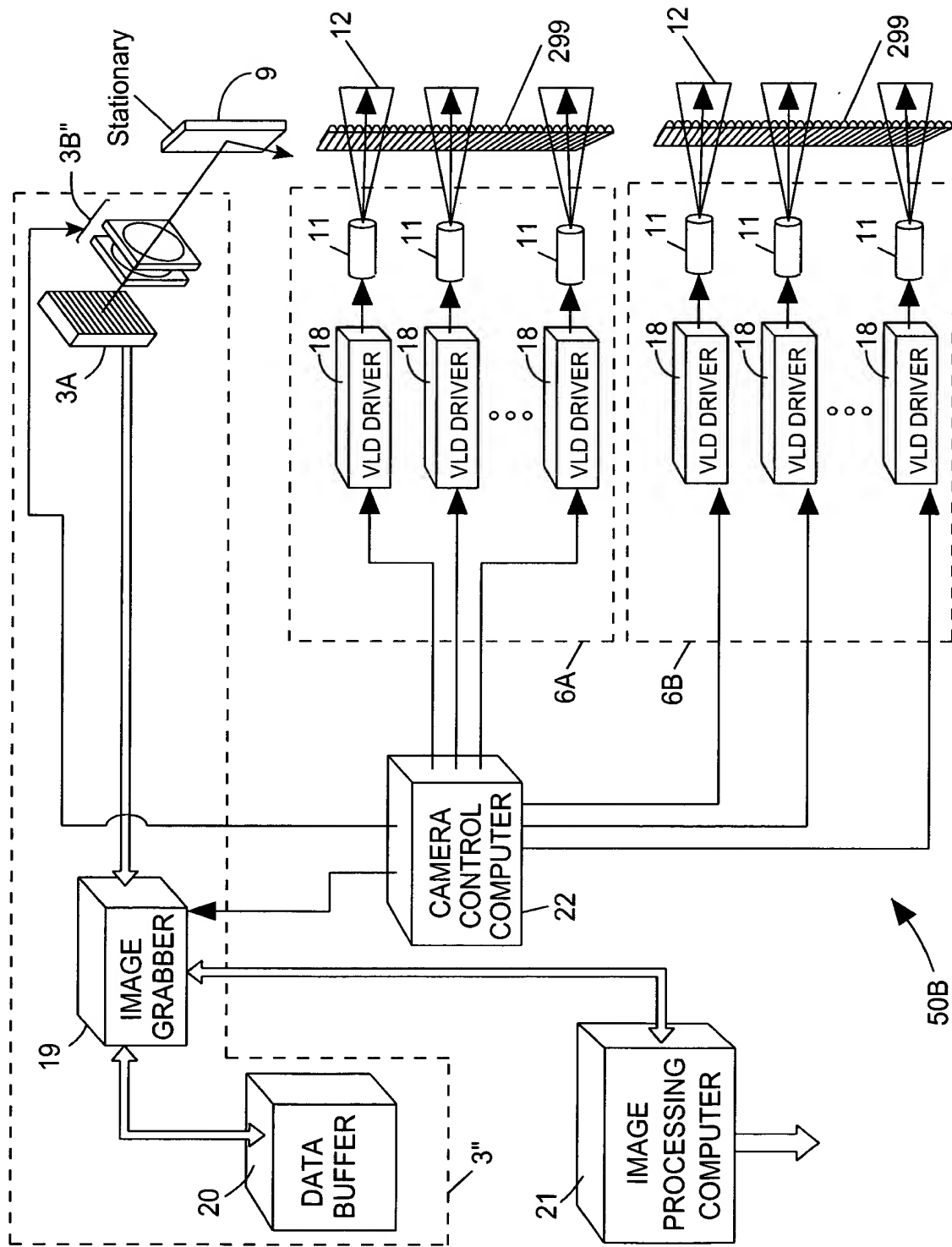


FIG. 3E2

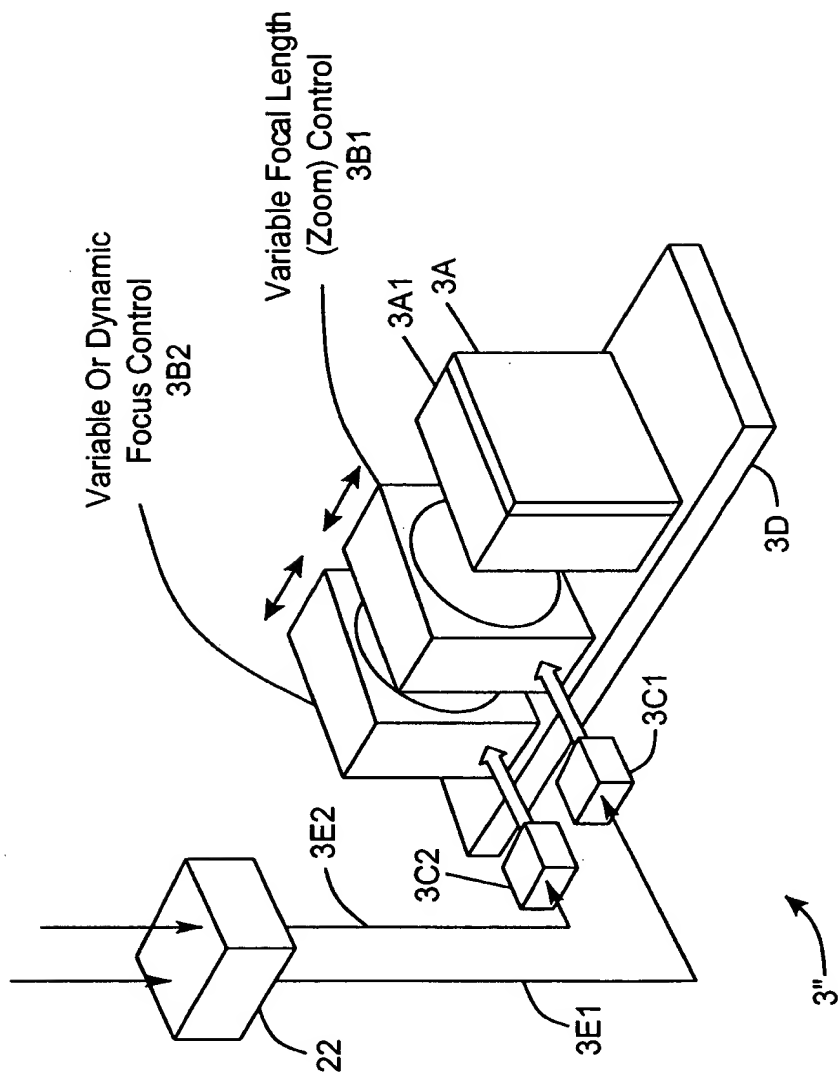


FIG. 3E3

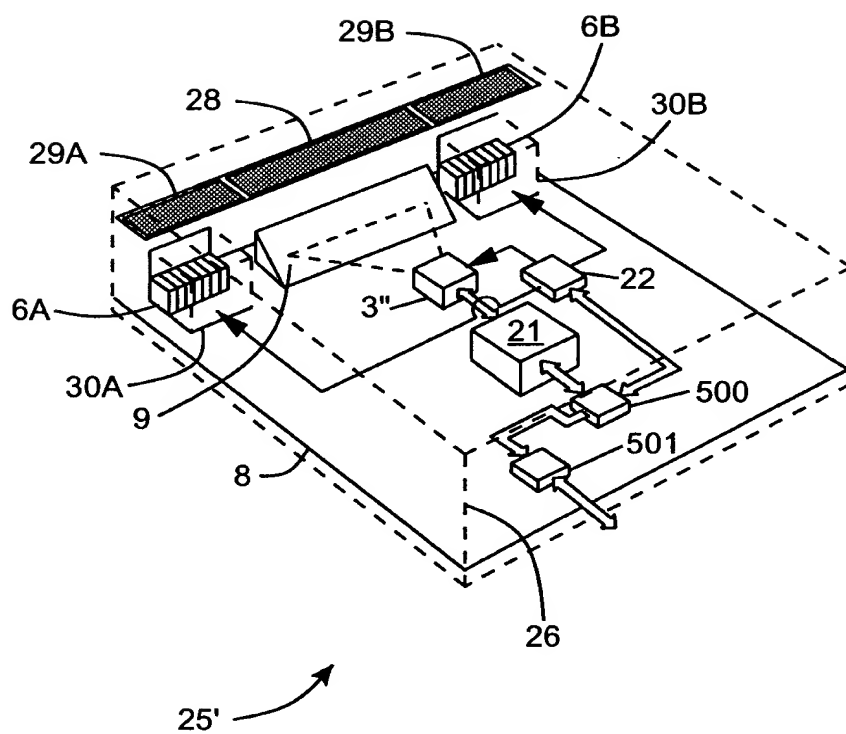


FIG. 3E4

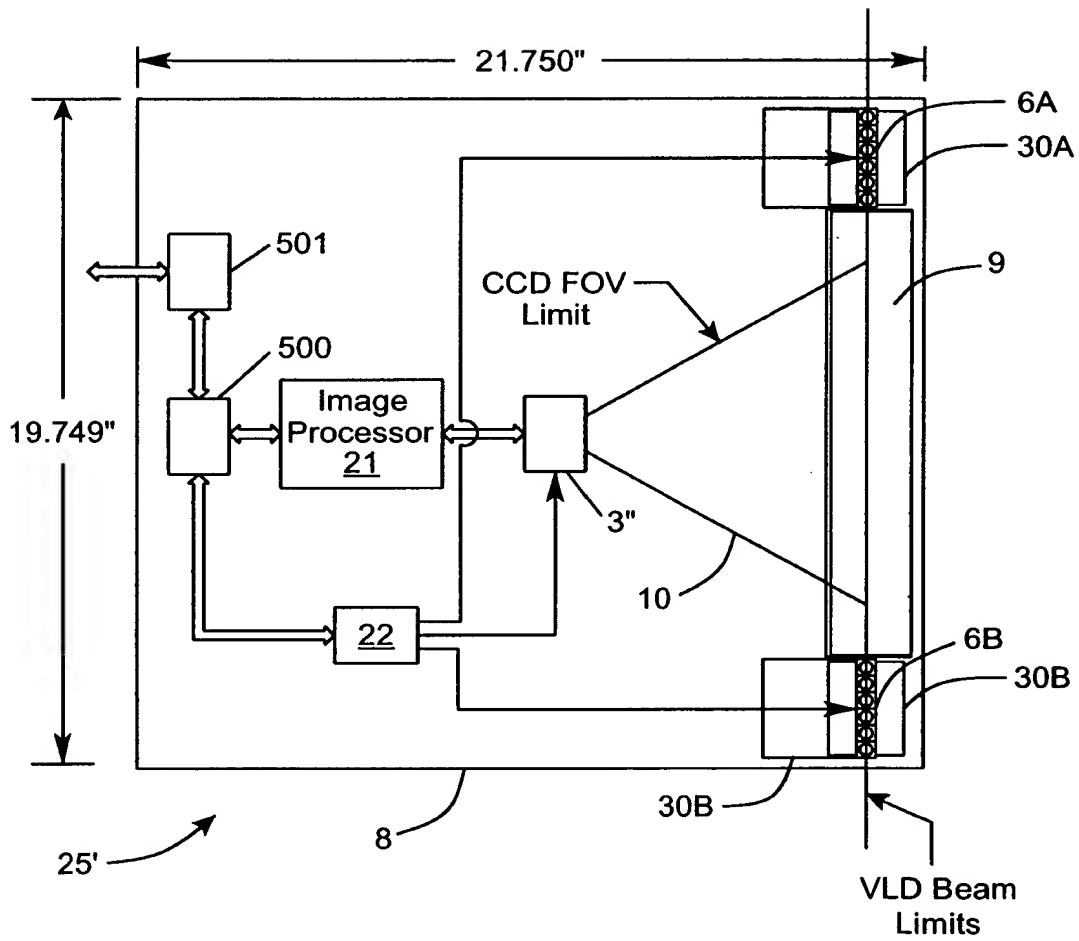


FIG. 3E5

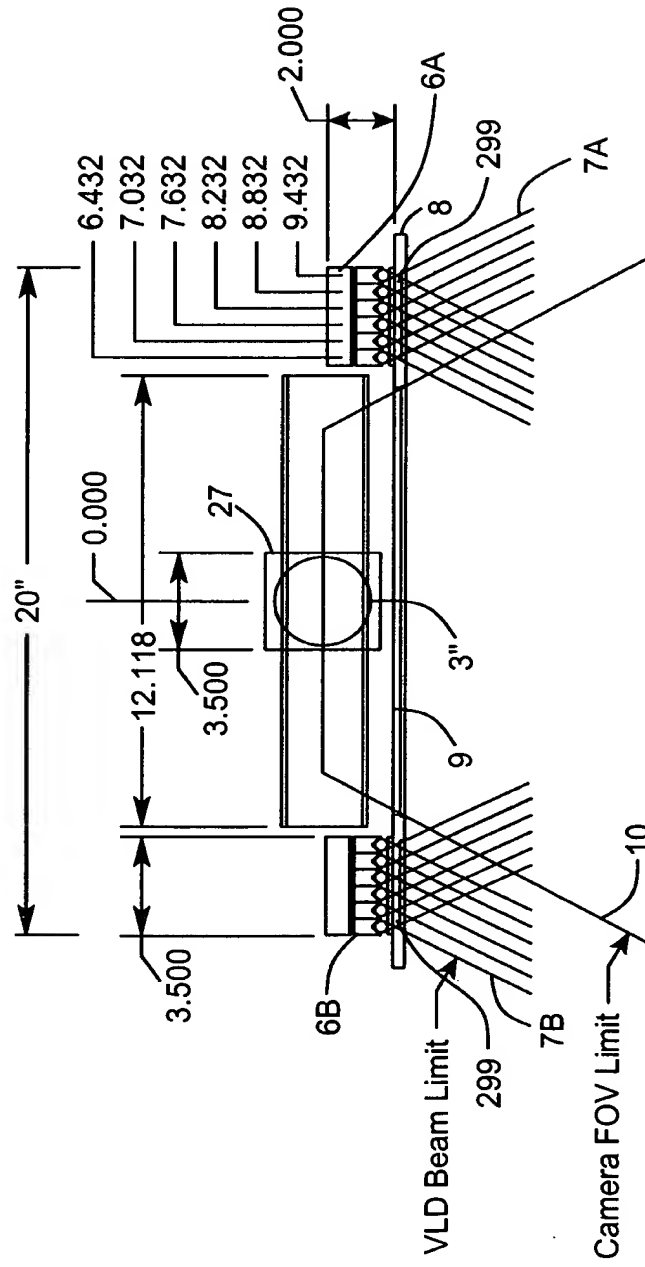


FIG. 3E6

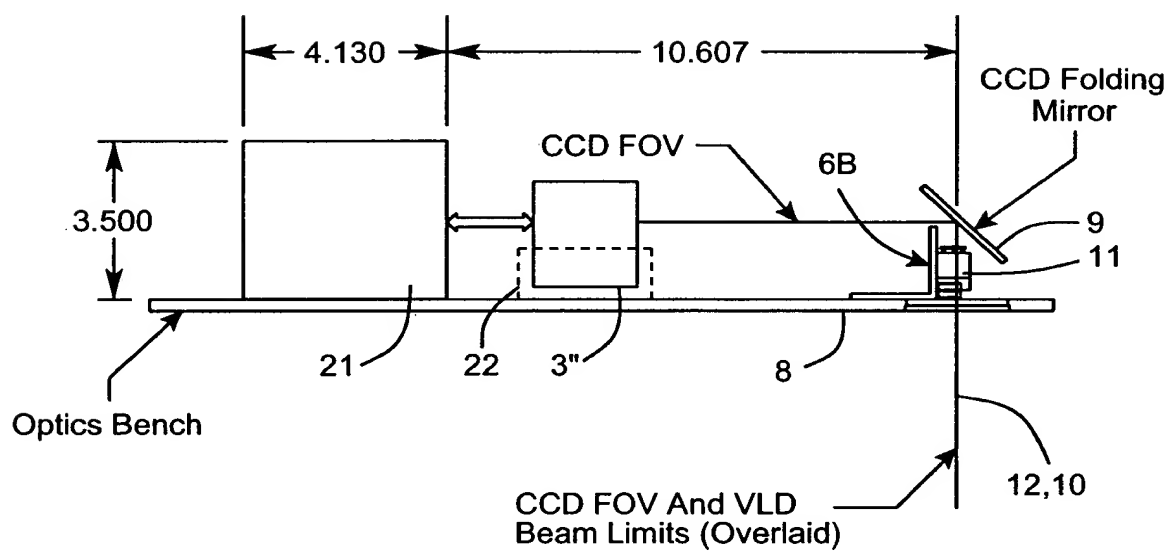


FIG. 3E7



* Variable FOV

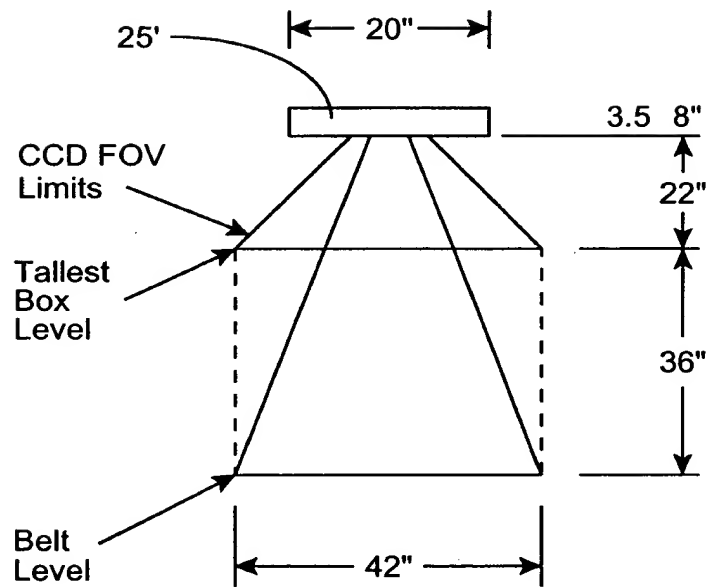


FIG. 3E8

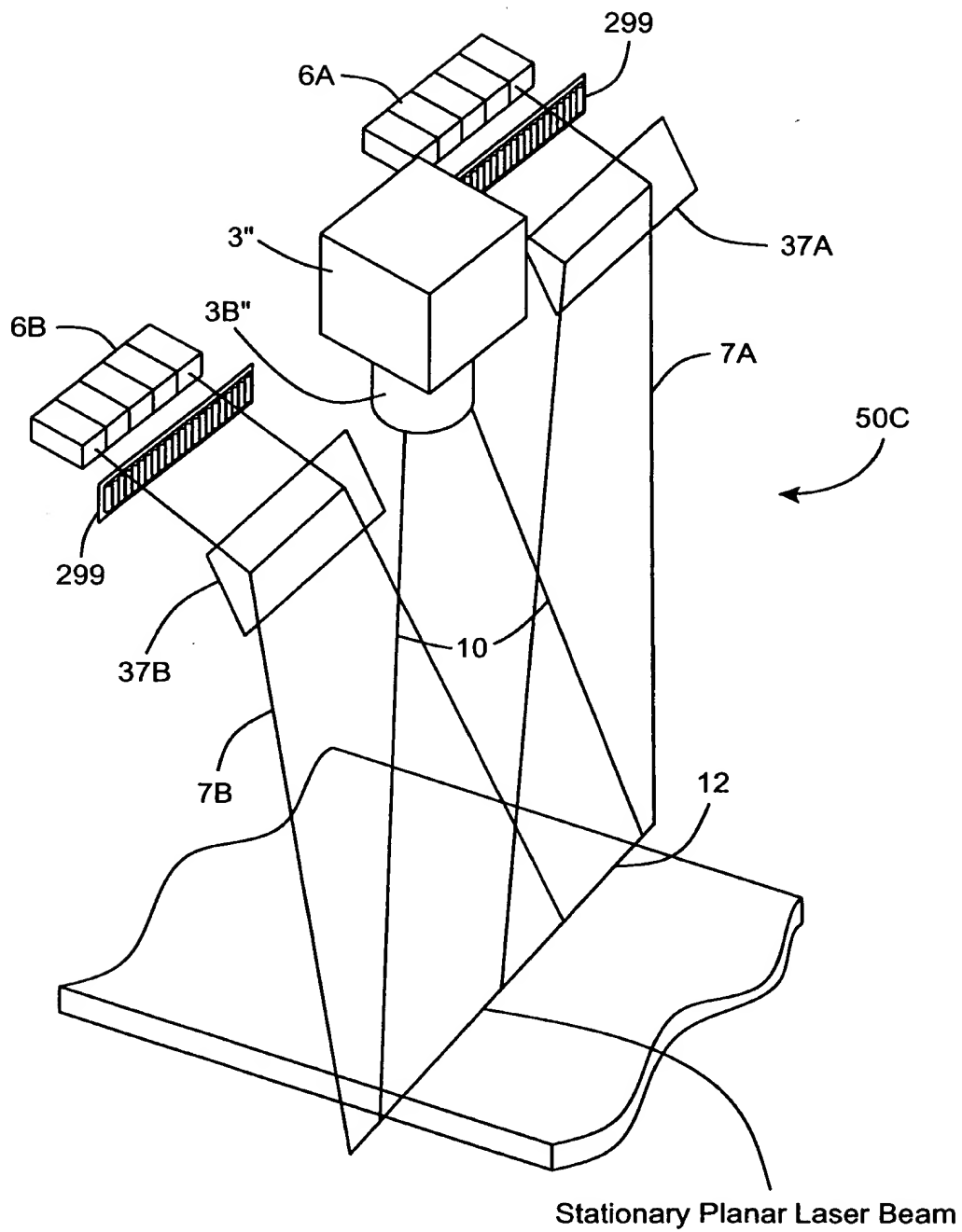


FIG. 3F1

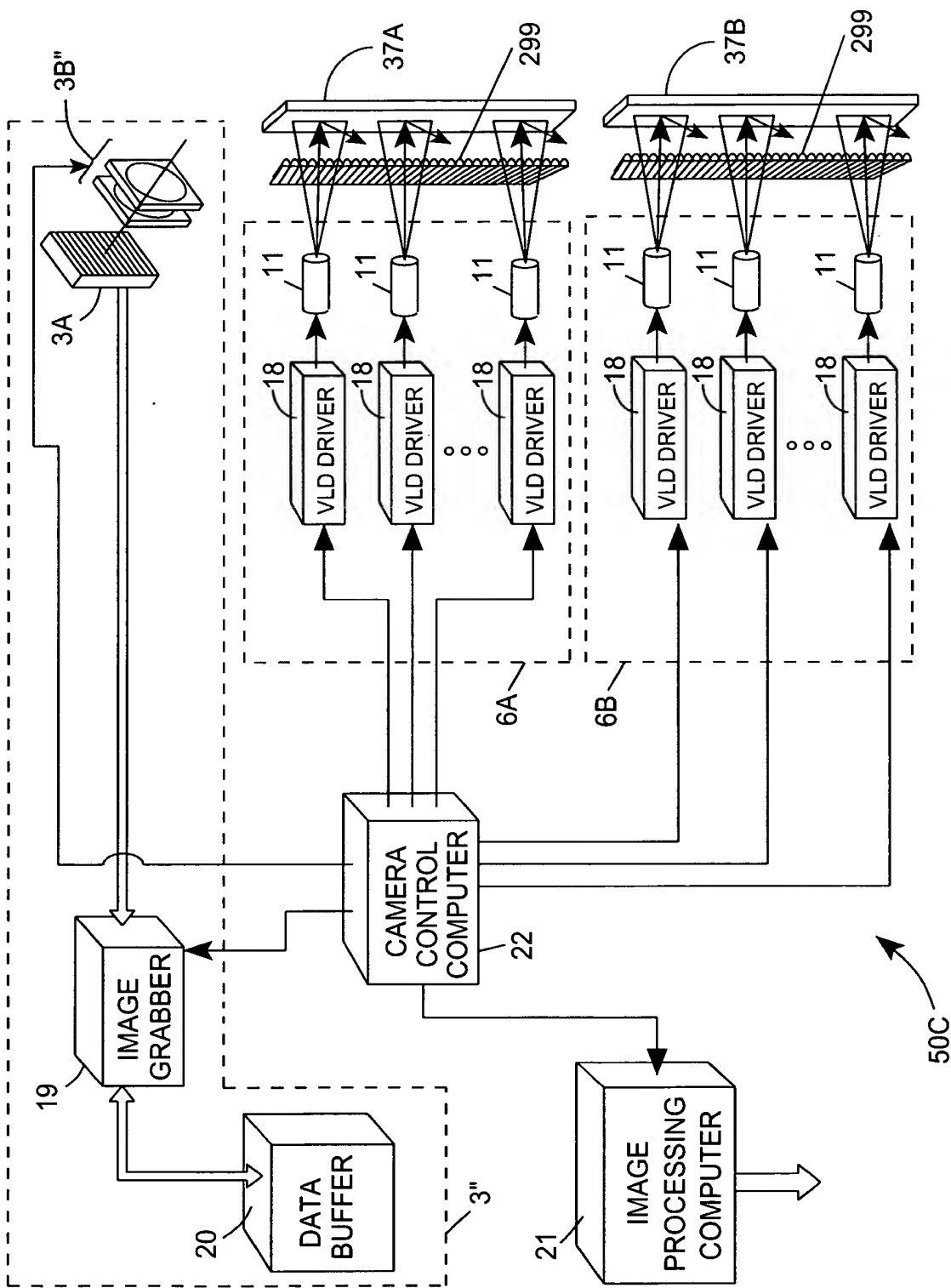


FIG. 3F2

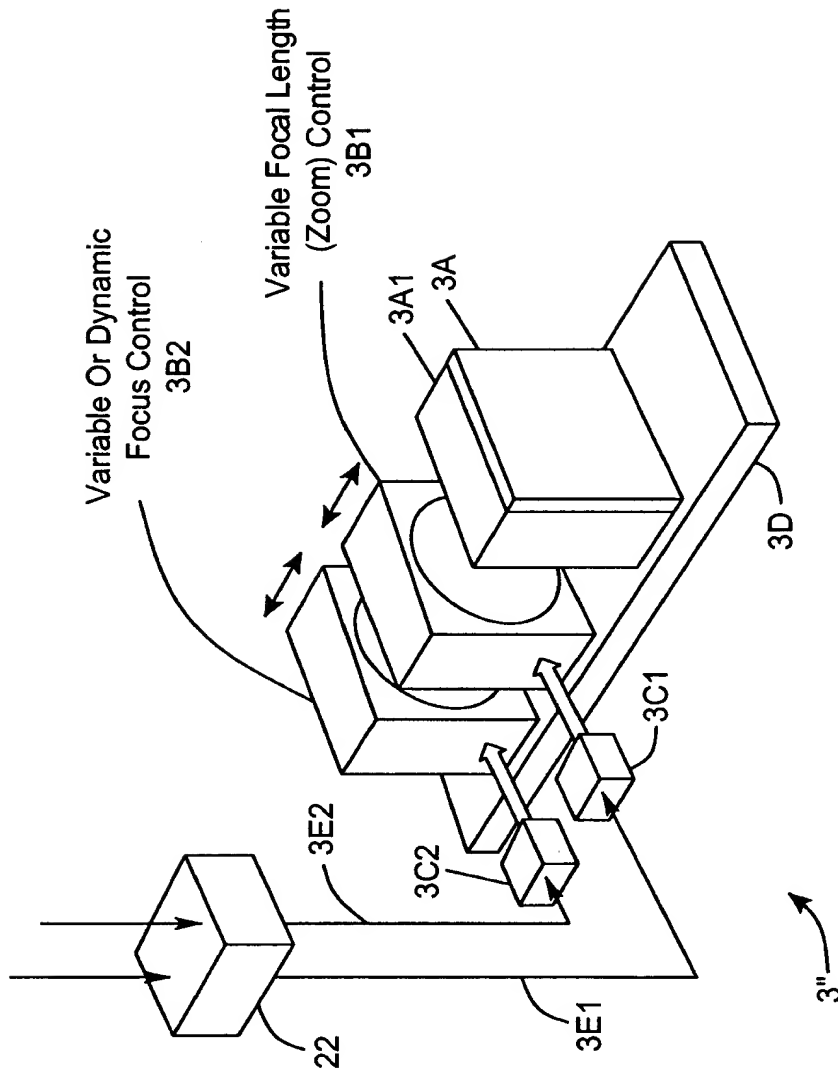


FIG. 3F3

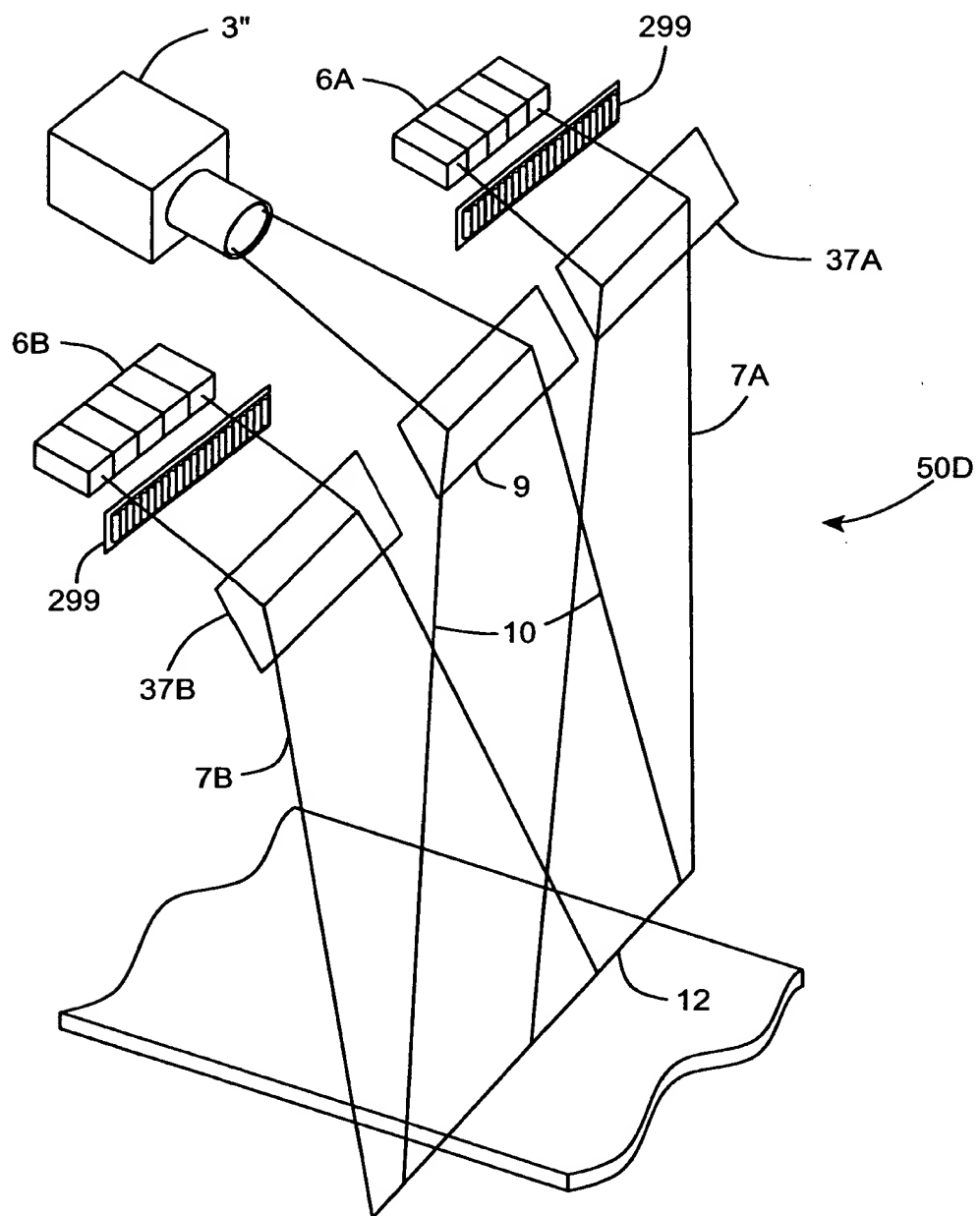


FIG. 3G1

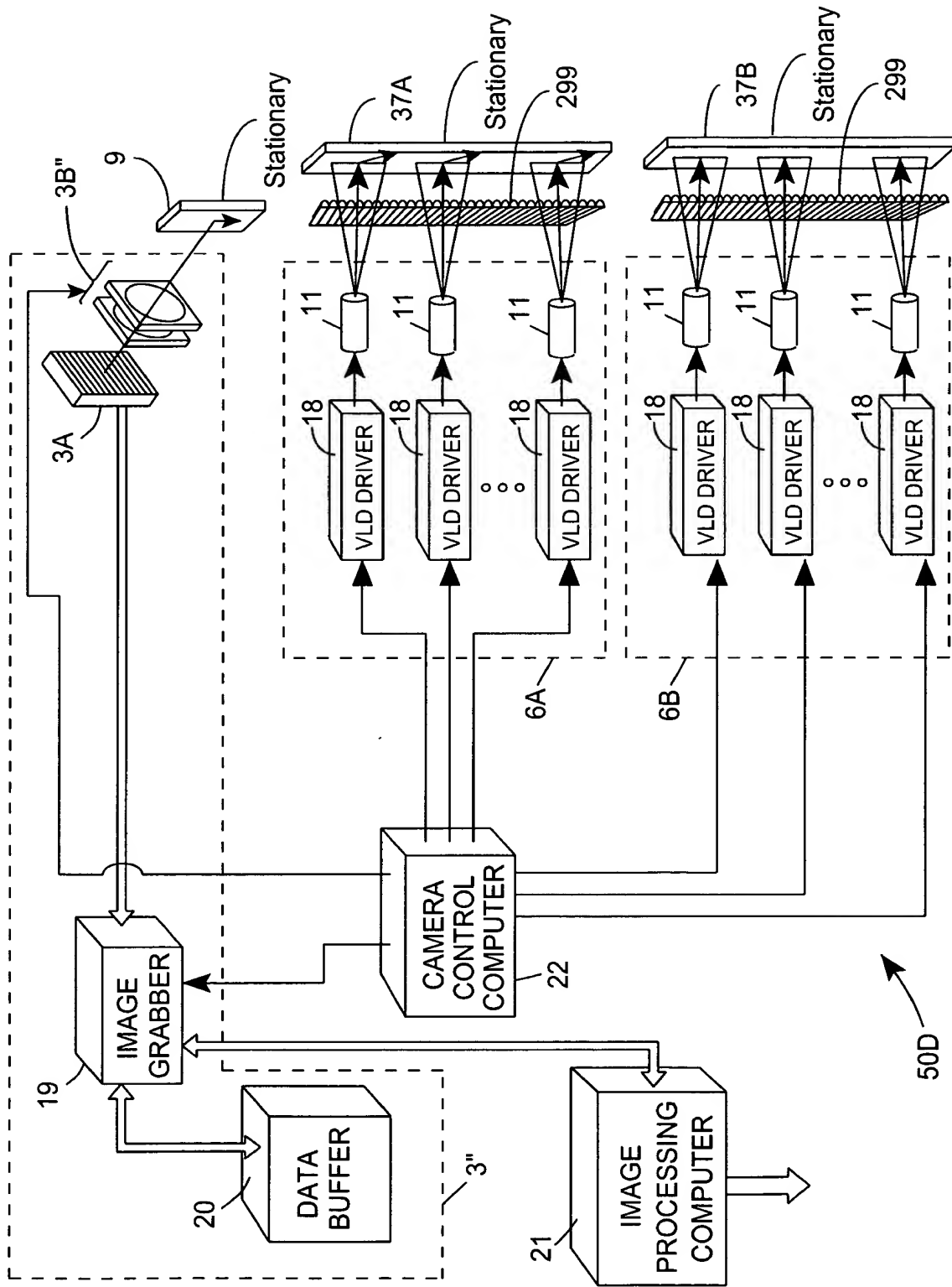
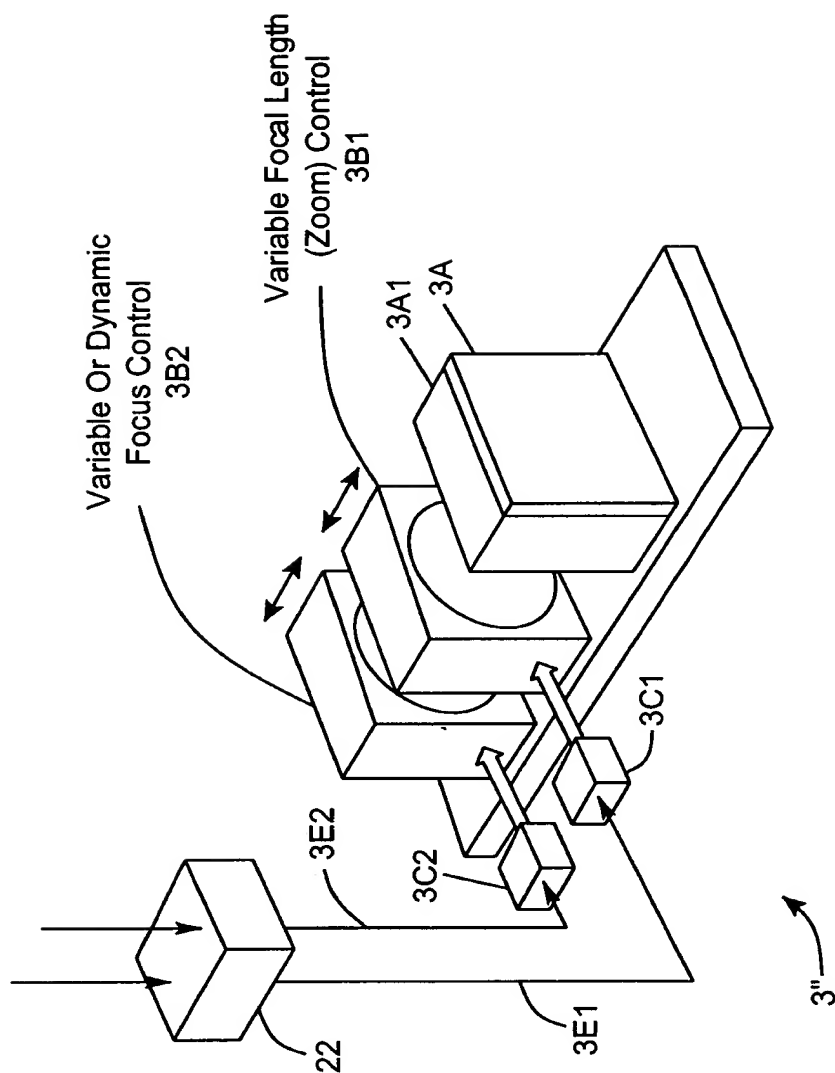


FIG. 3G2





- Variable Focal Length Imaging Lens
- Variable Focal Distance

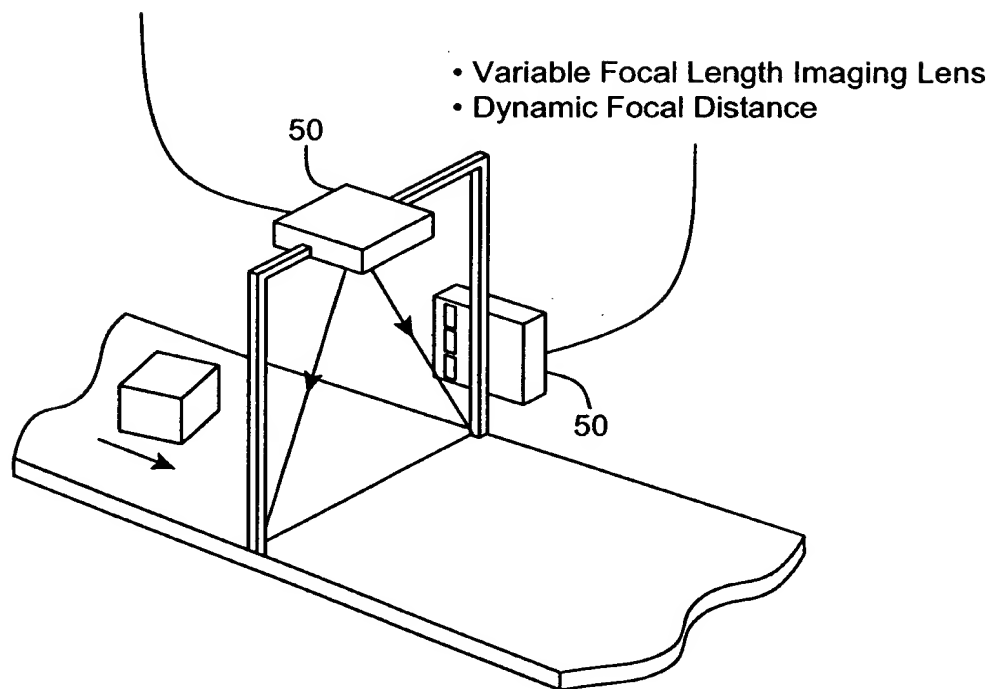


FIG. 3H

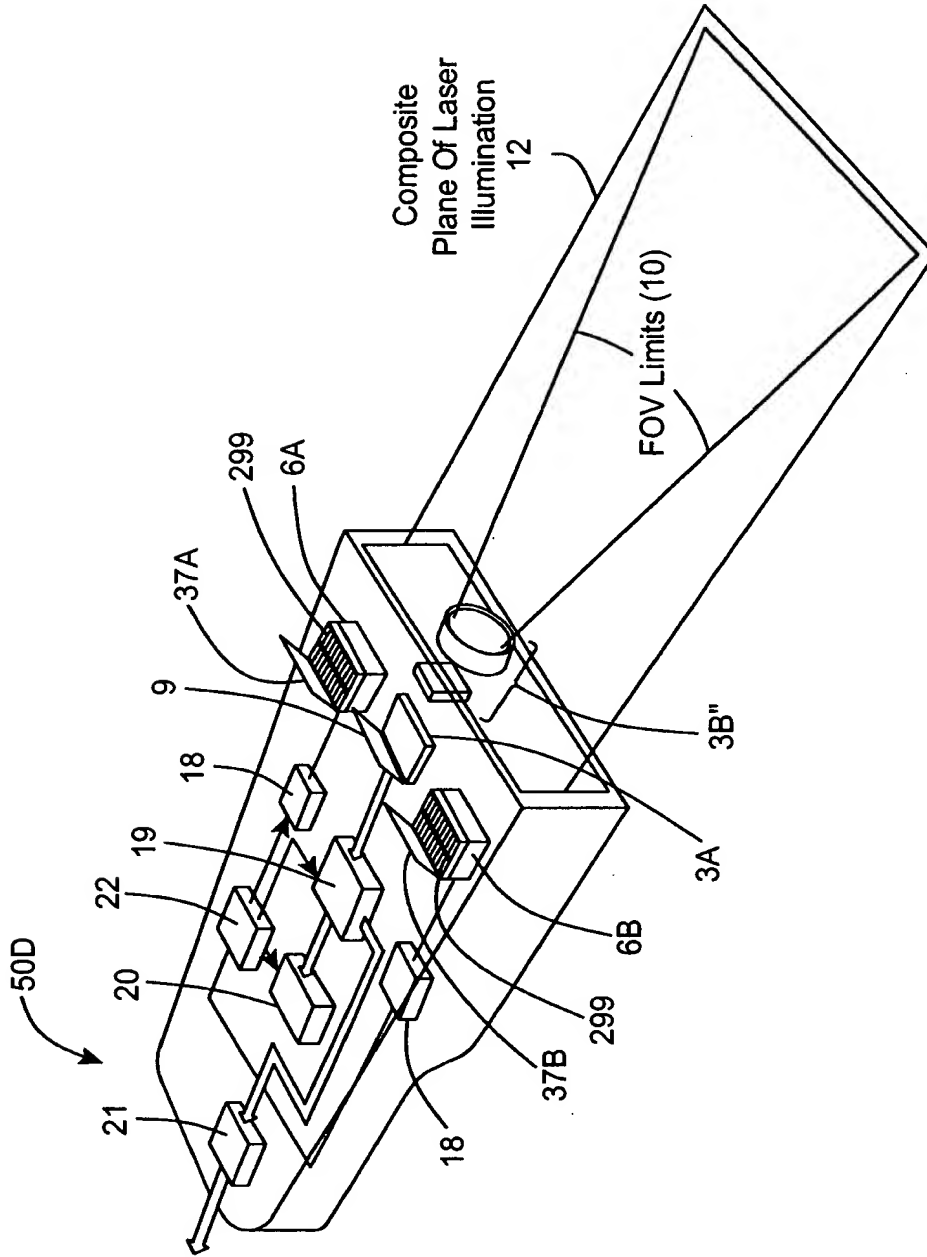


FIG. 31

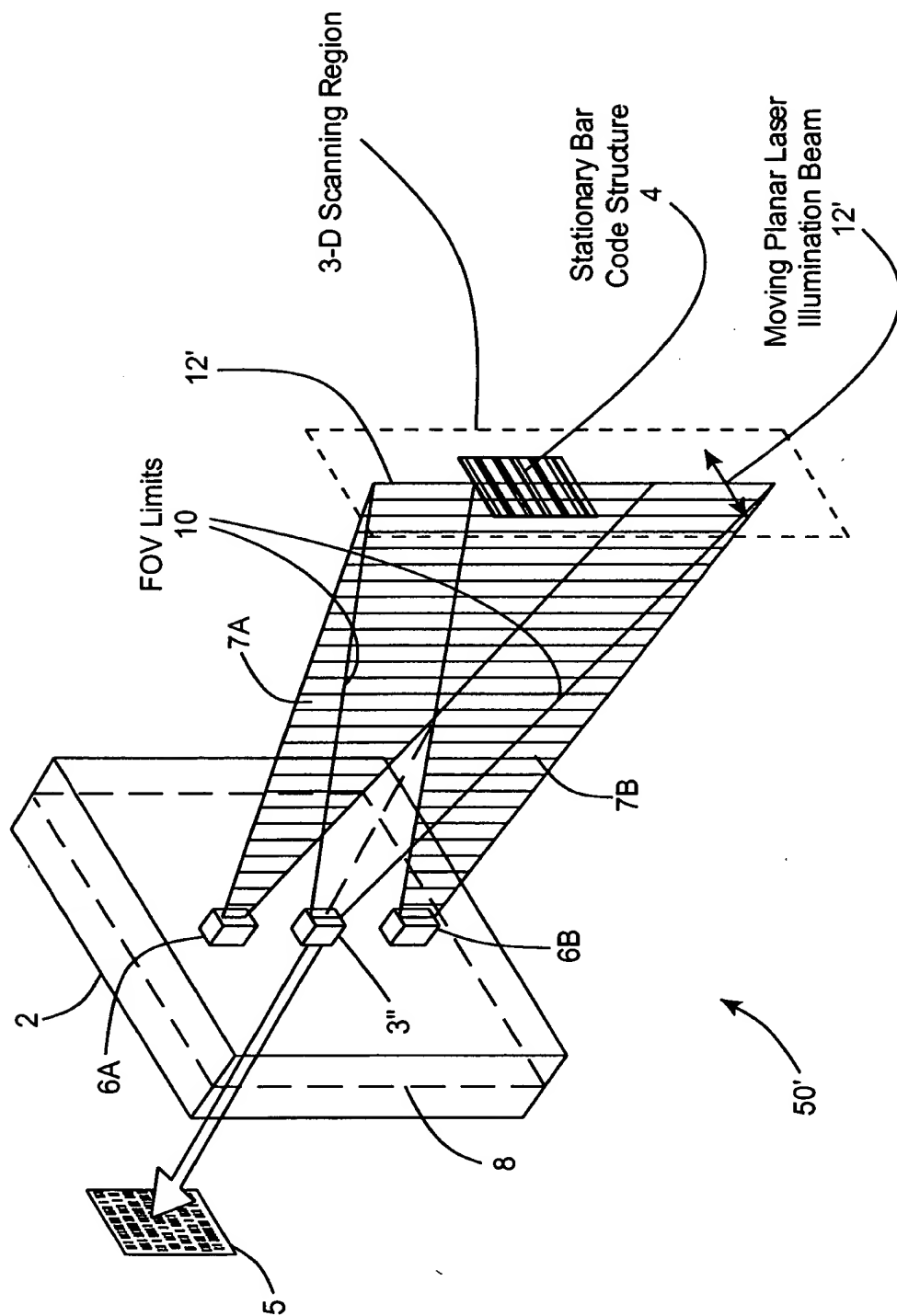


FIG. 3J1

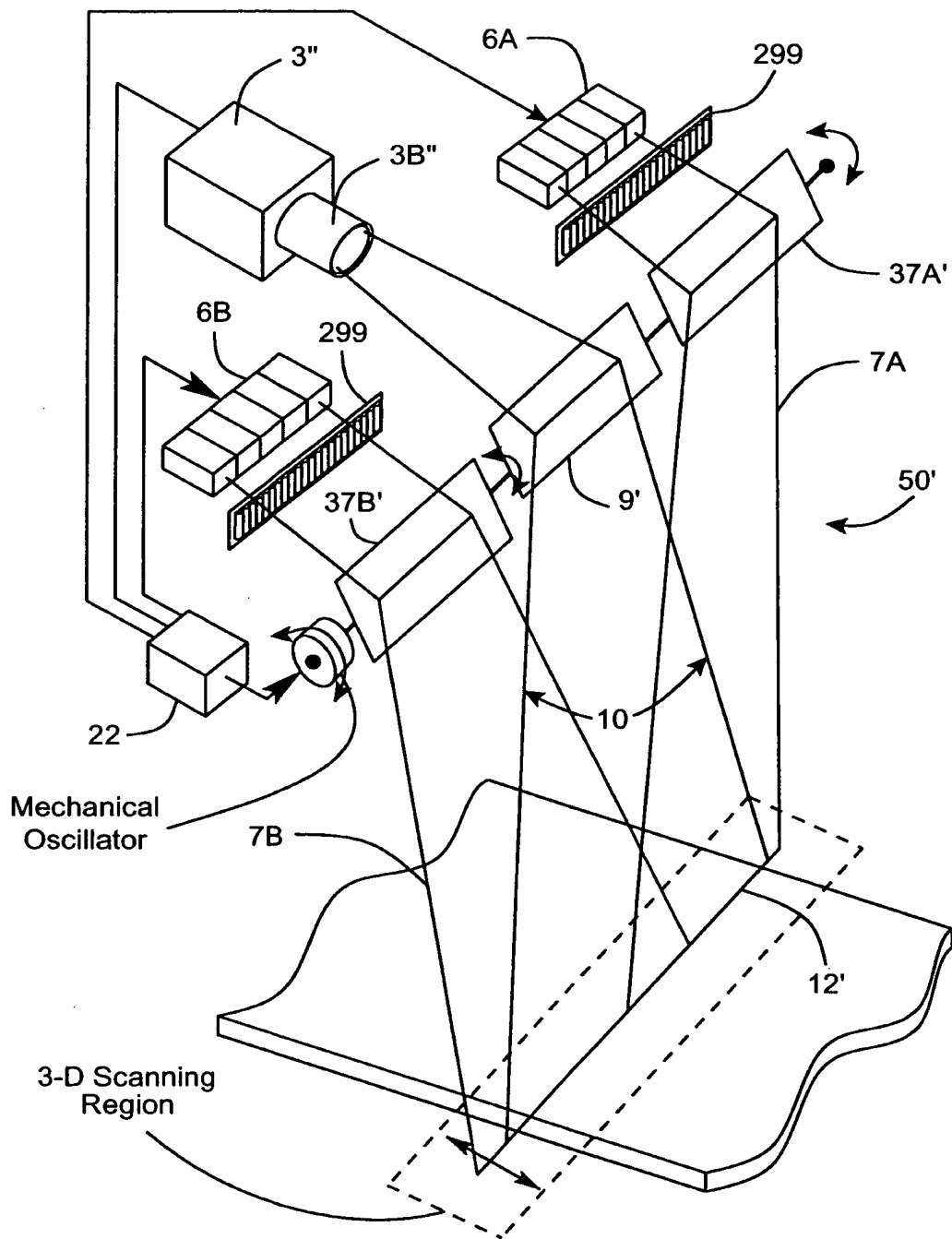
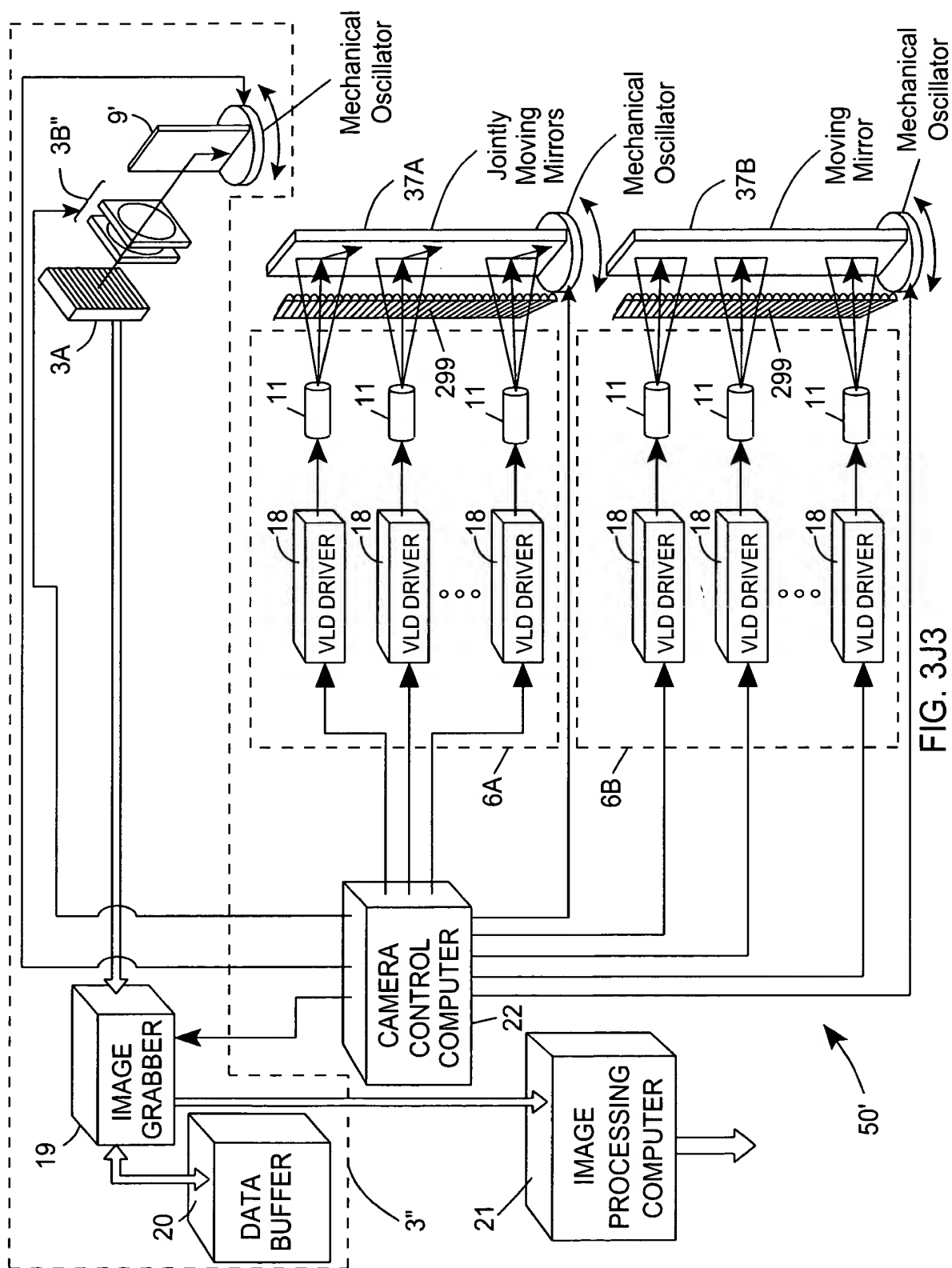


FIG. 3J2



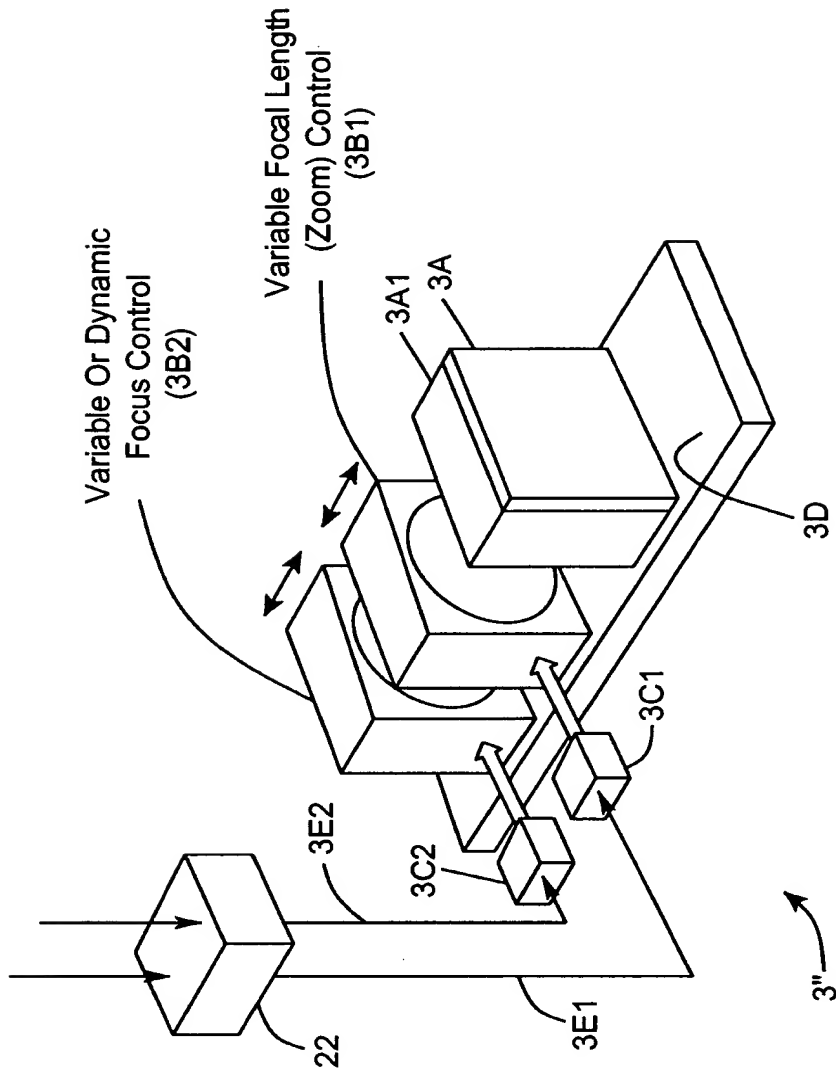
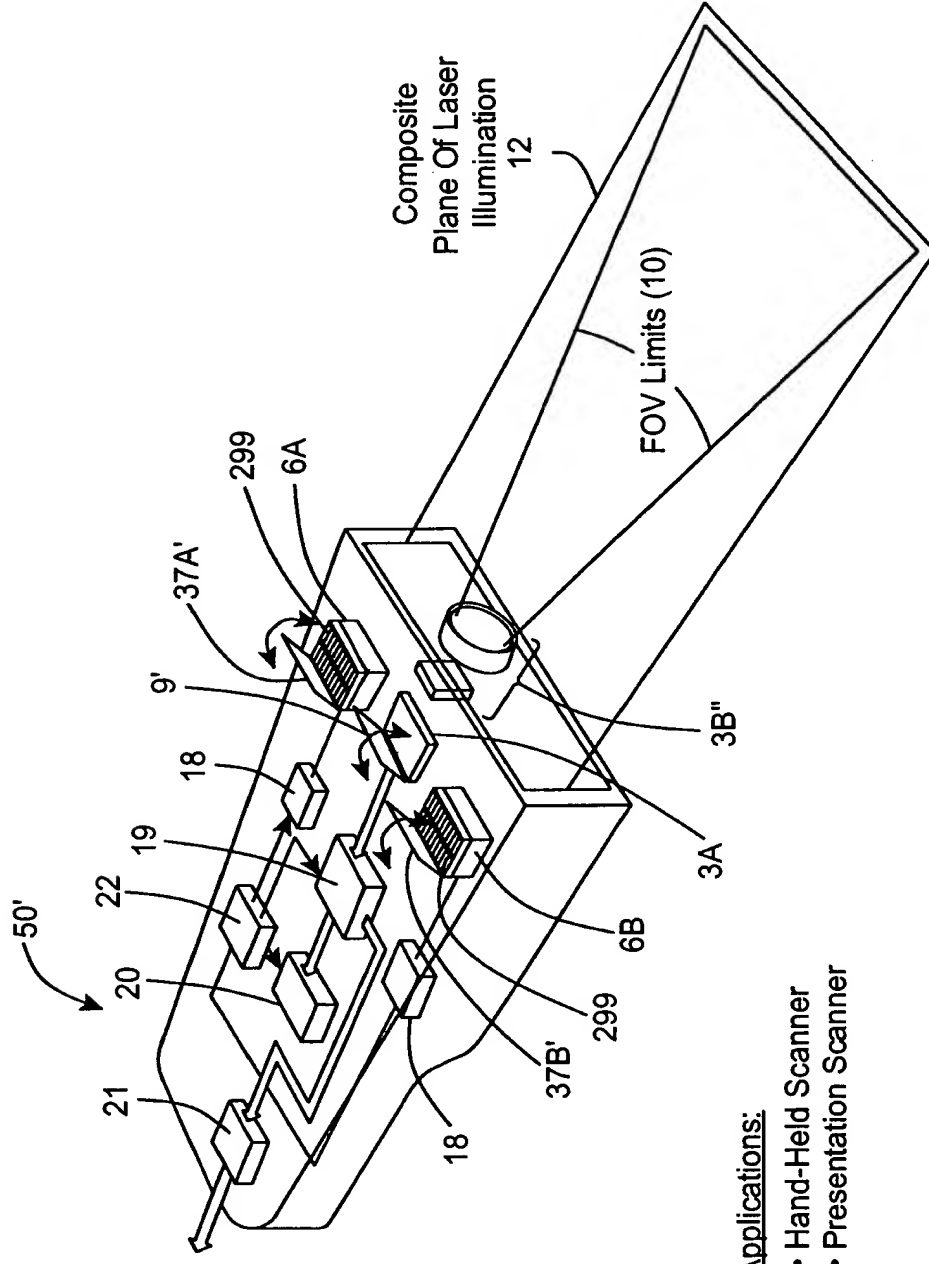
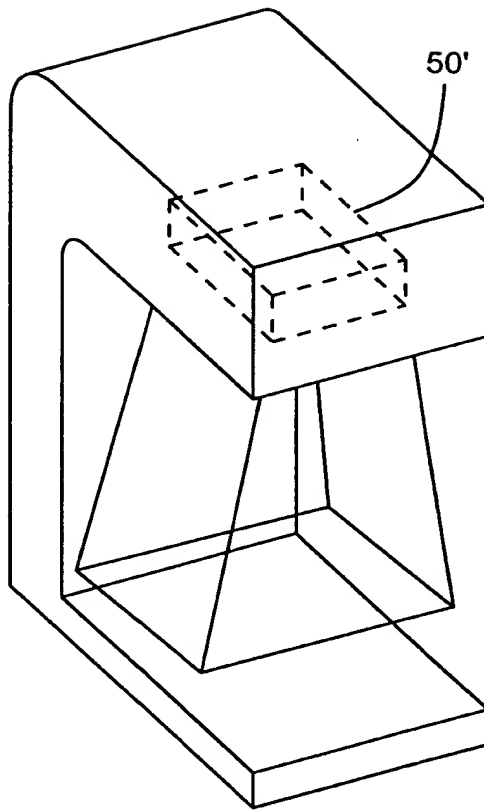


FIG. 3J4



- Applications:
- Hand-Held Scanner
 - Presentation Scanner

FIG. 3J5



2-D Hold-under Scanner

FIG. 3J6

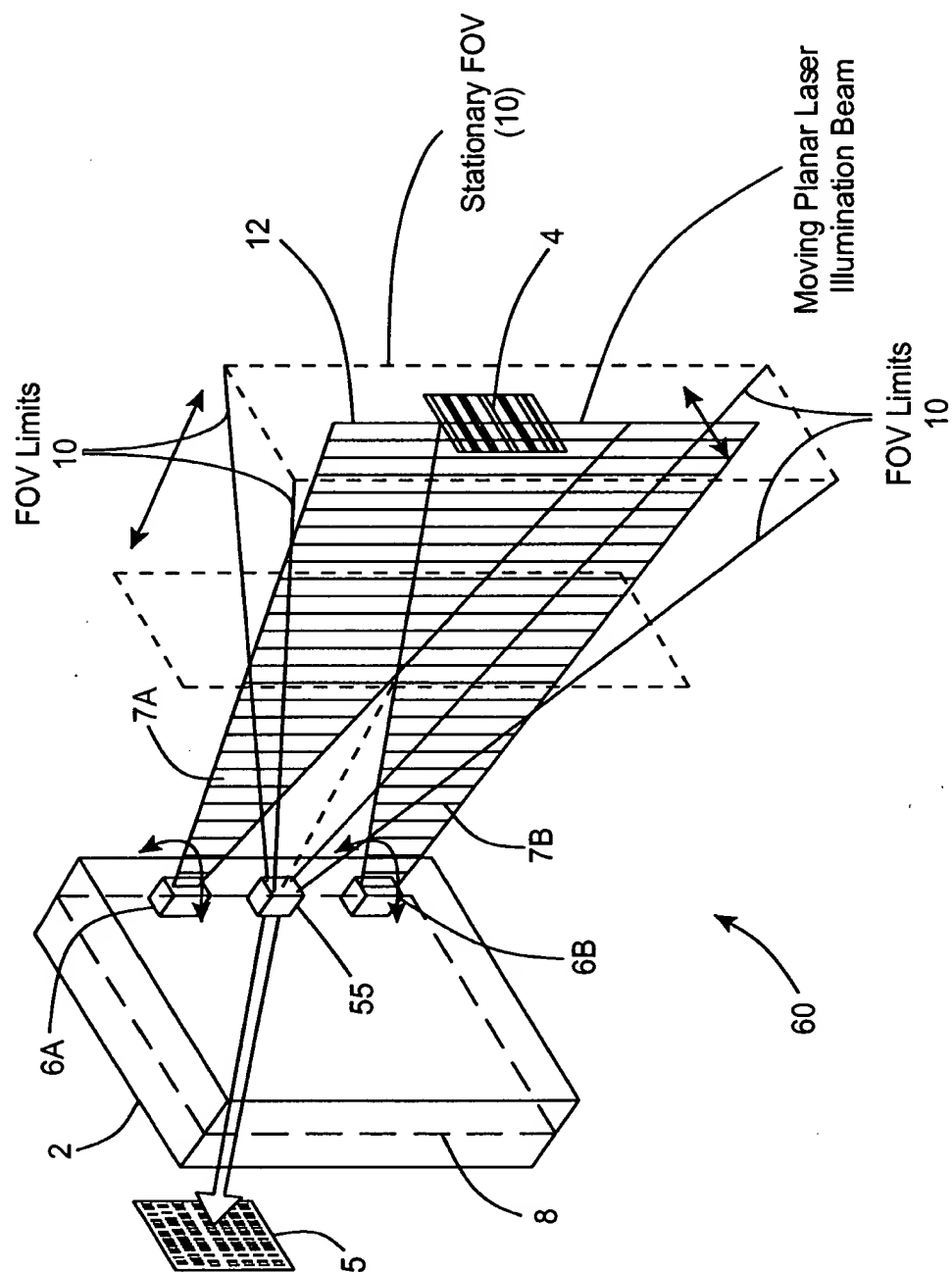


FIG. 4A

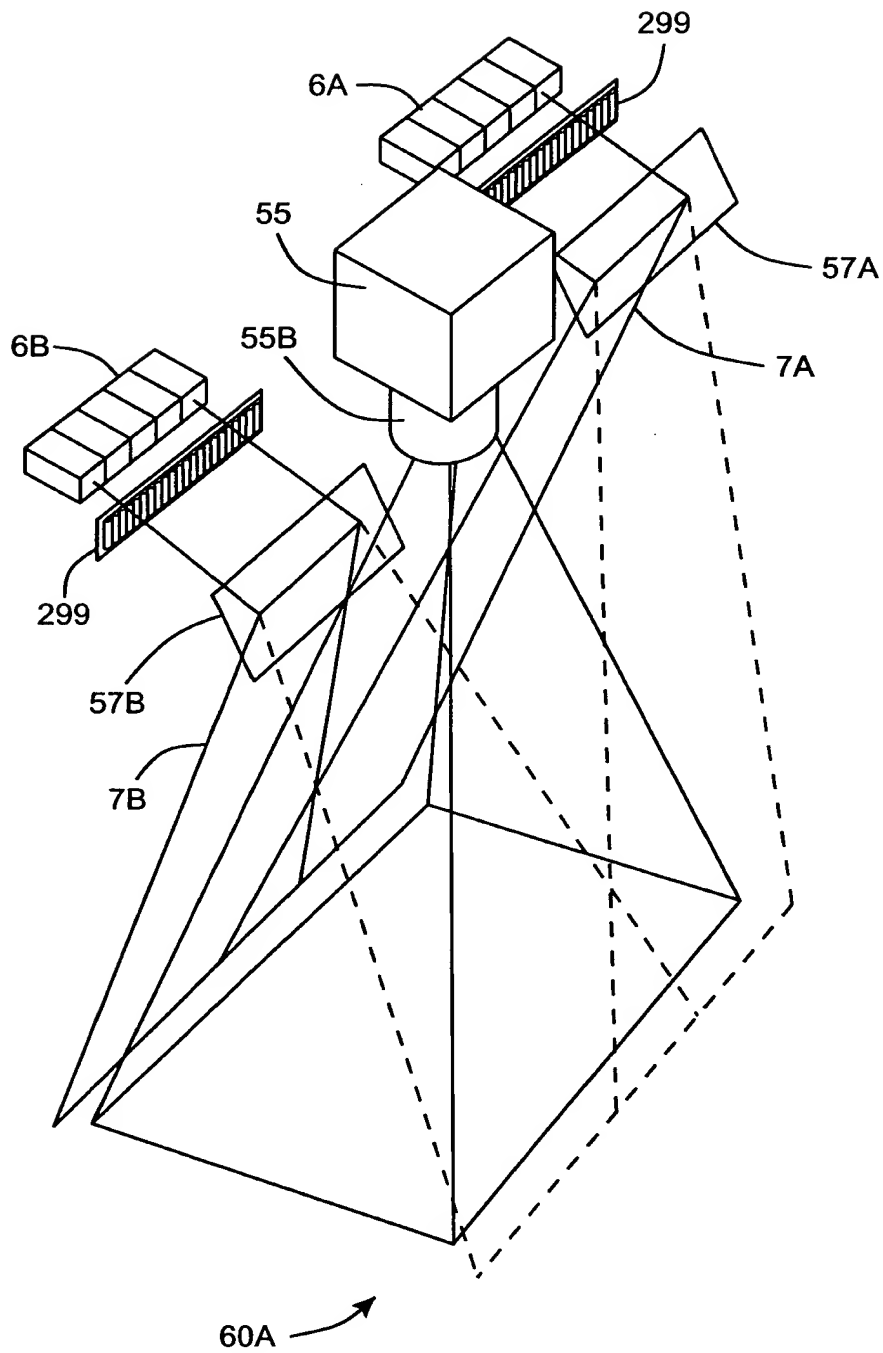


FIG. 4B1

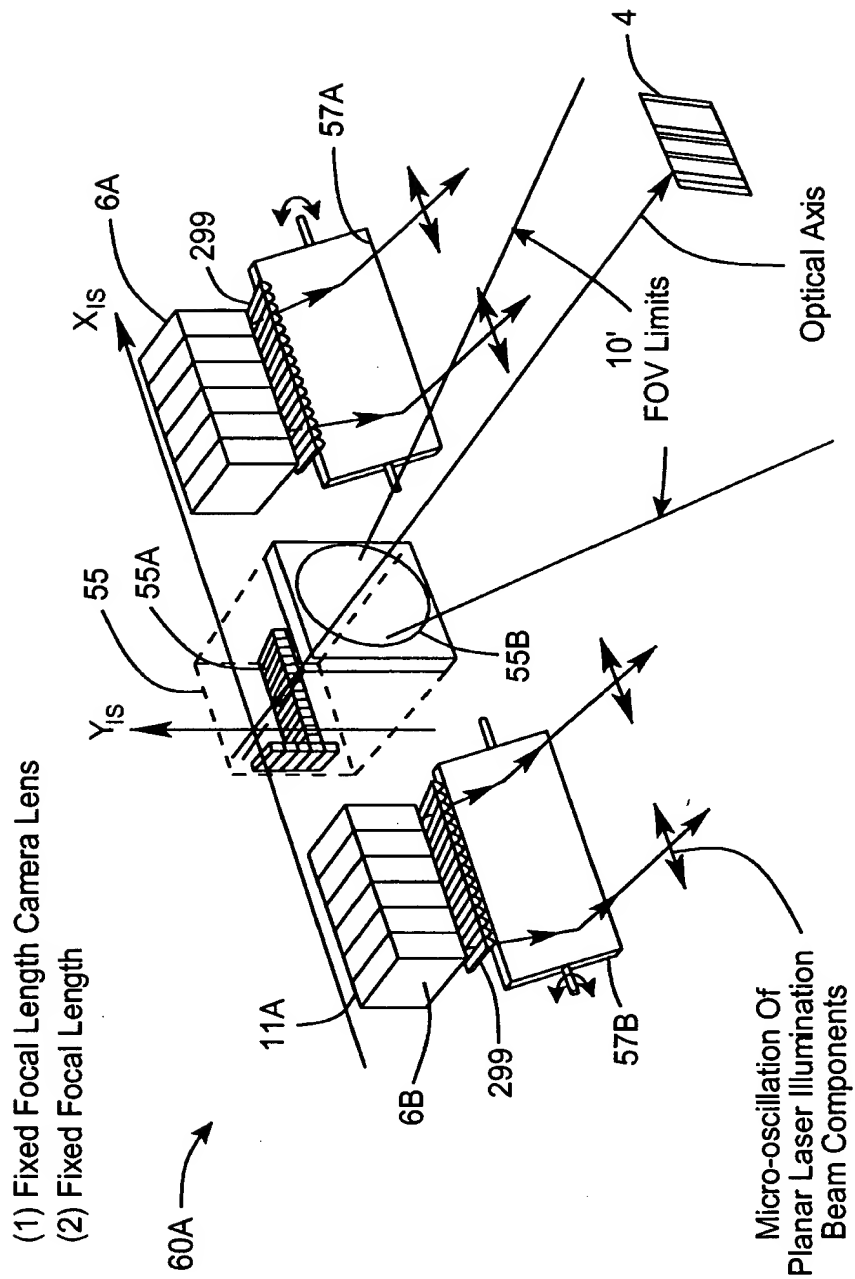


FIG. 4B2

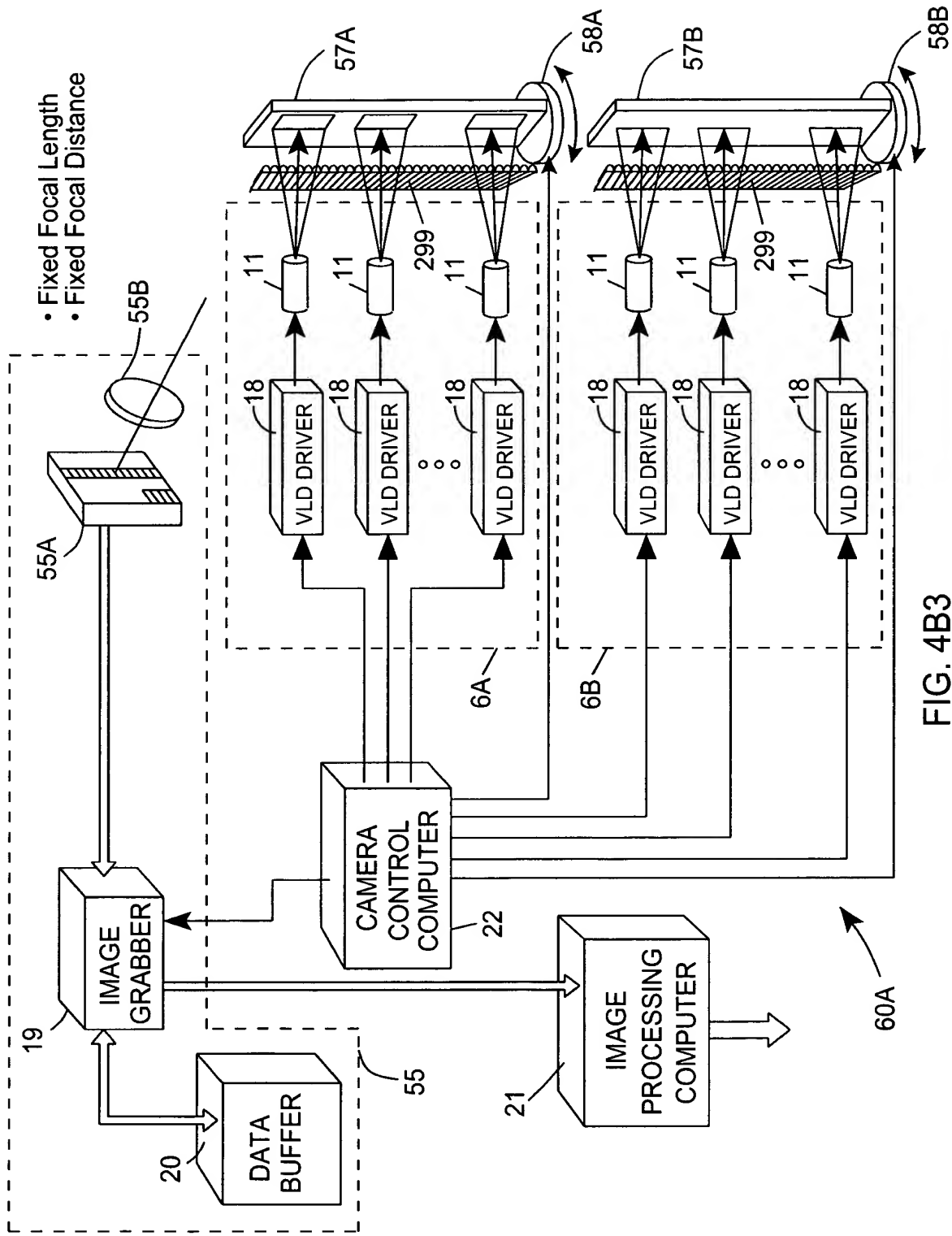


FIG. 4B3

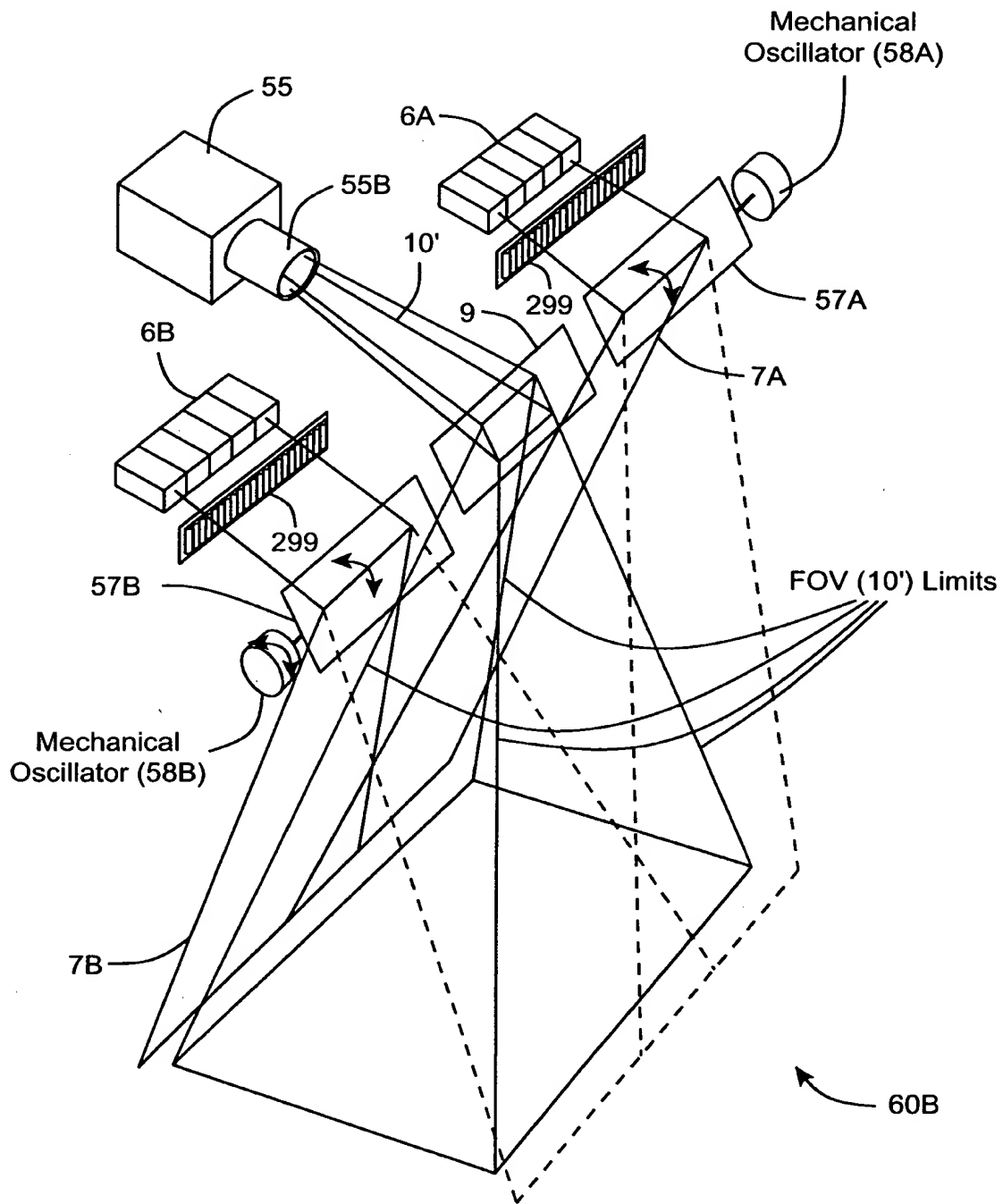
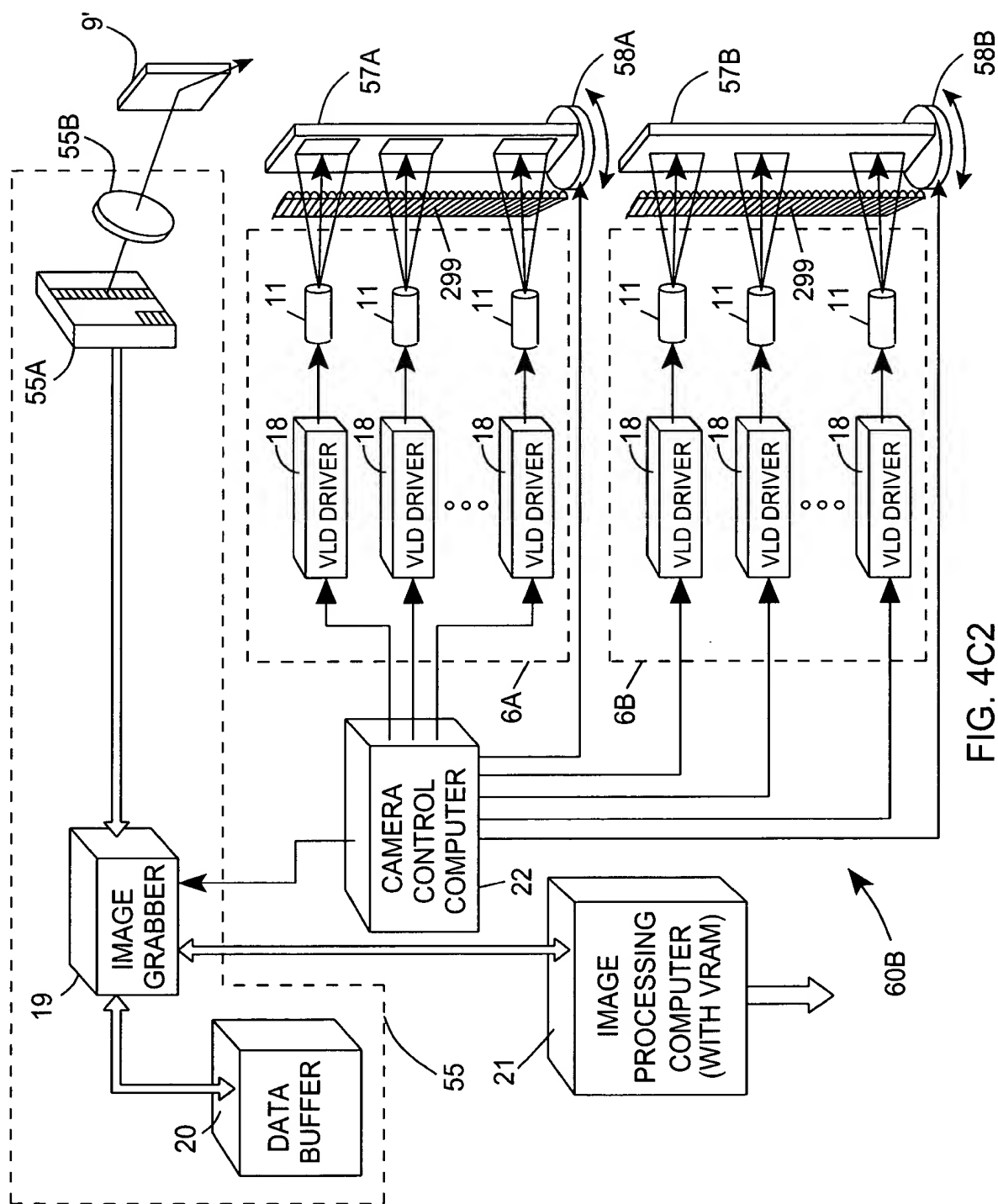
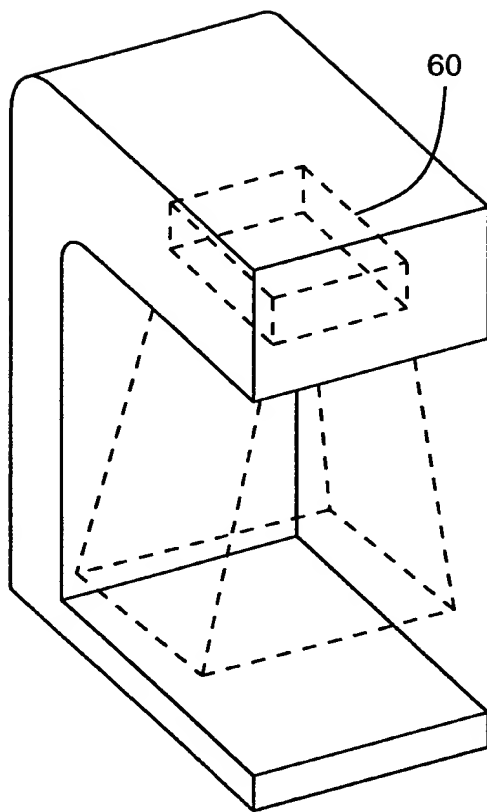


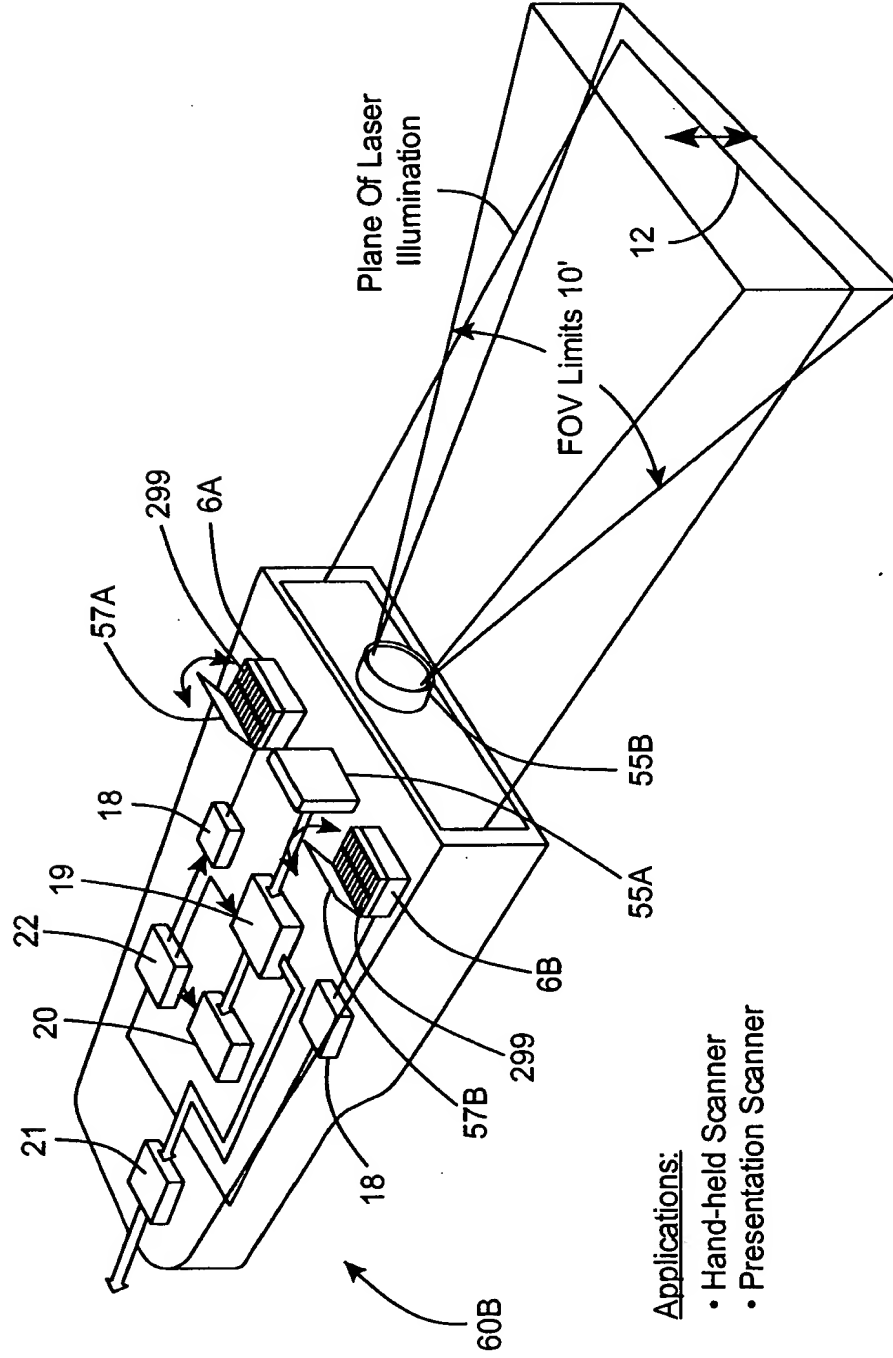
FIG. 4C1





2-D Hold-under Scanner

FIG. 4D



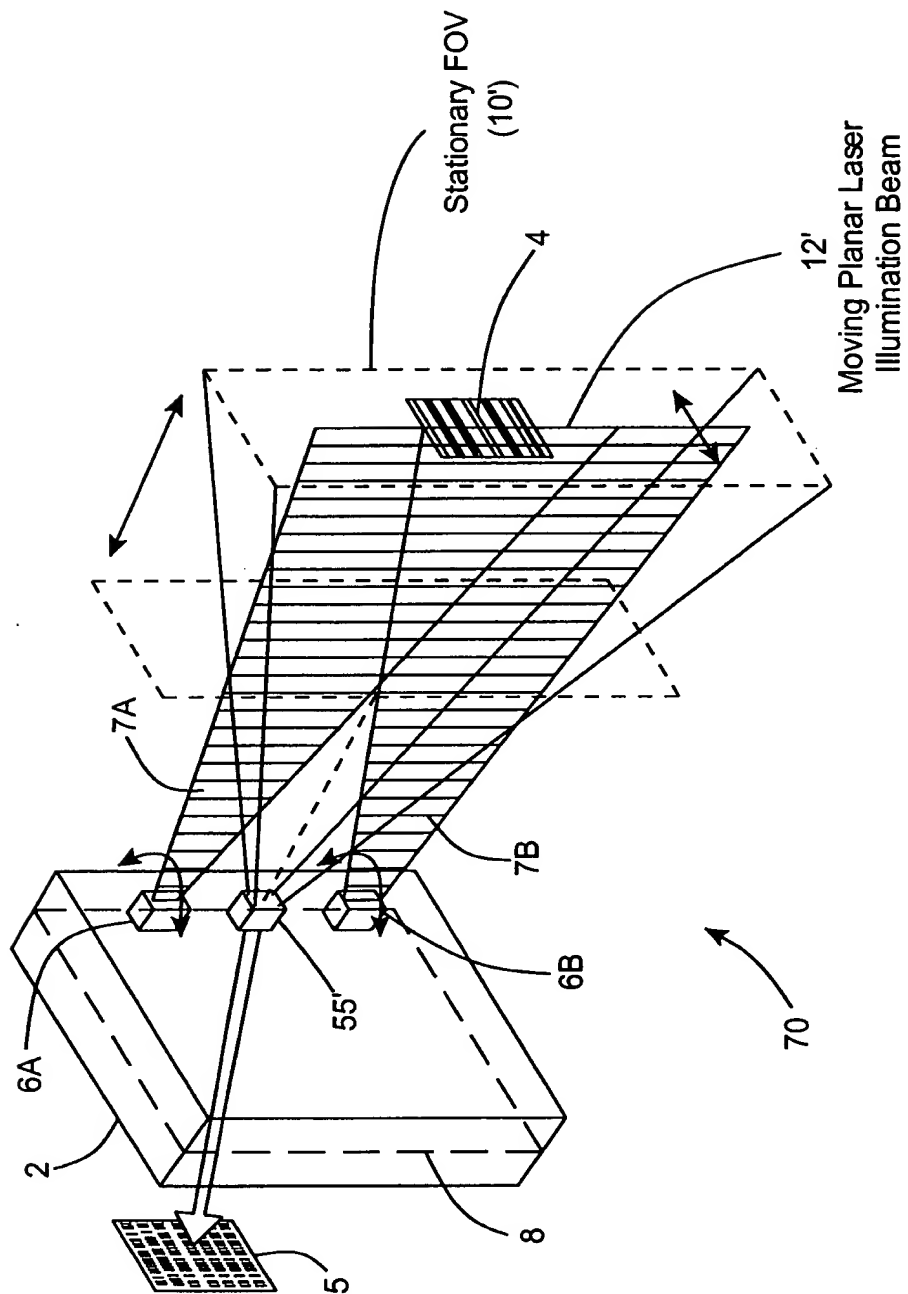


FIG. 5A

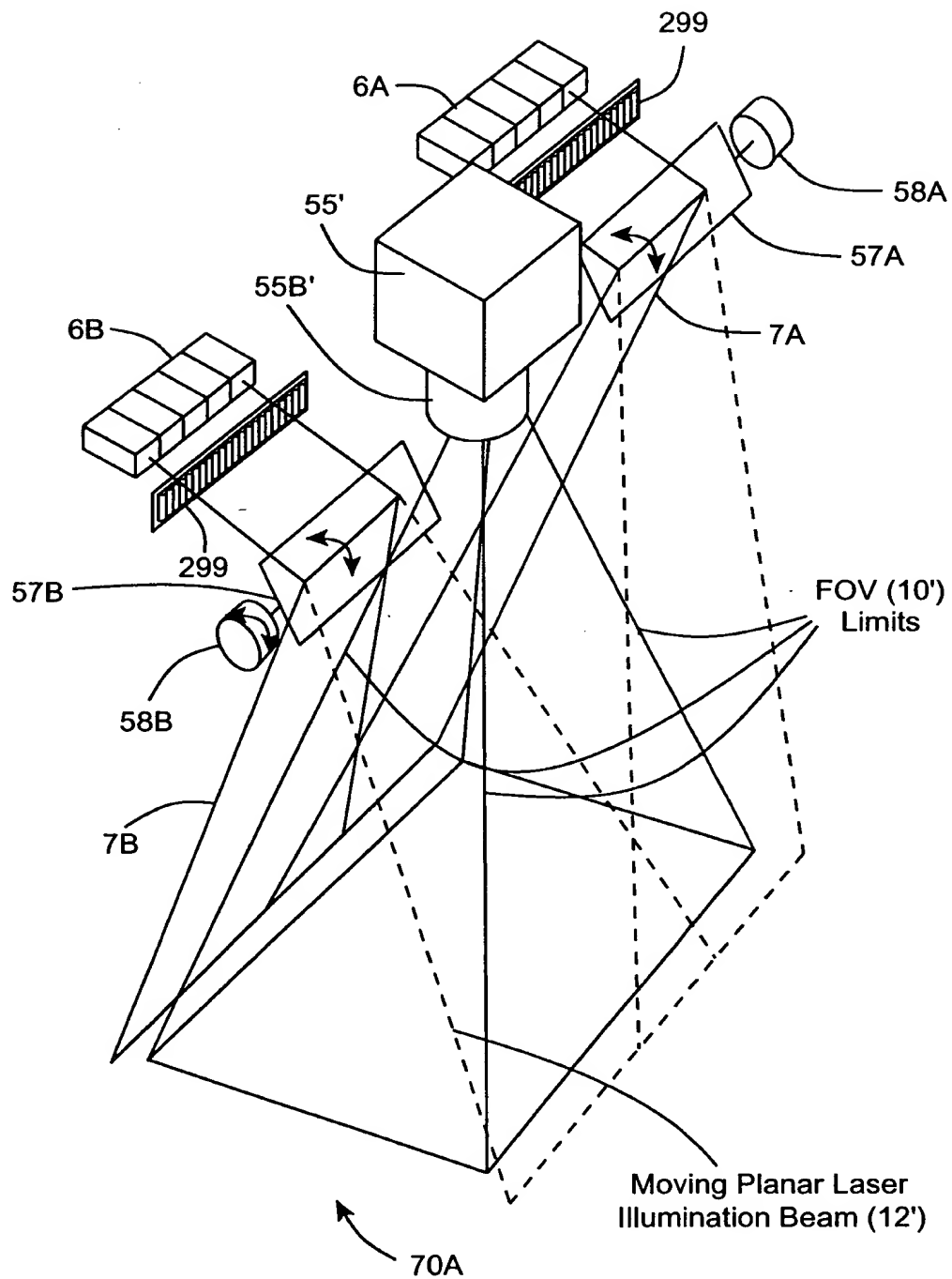


FIG. 5B1

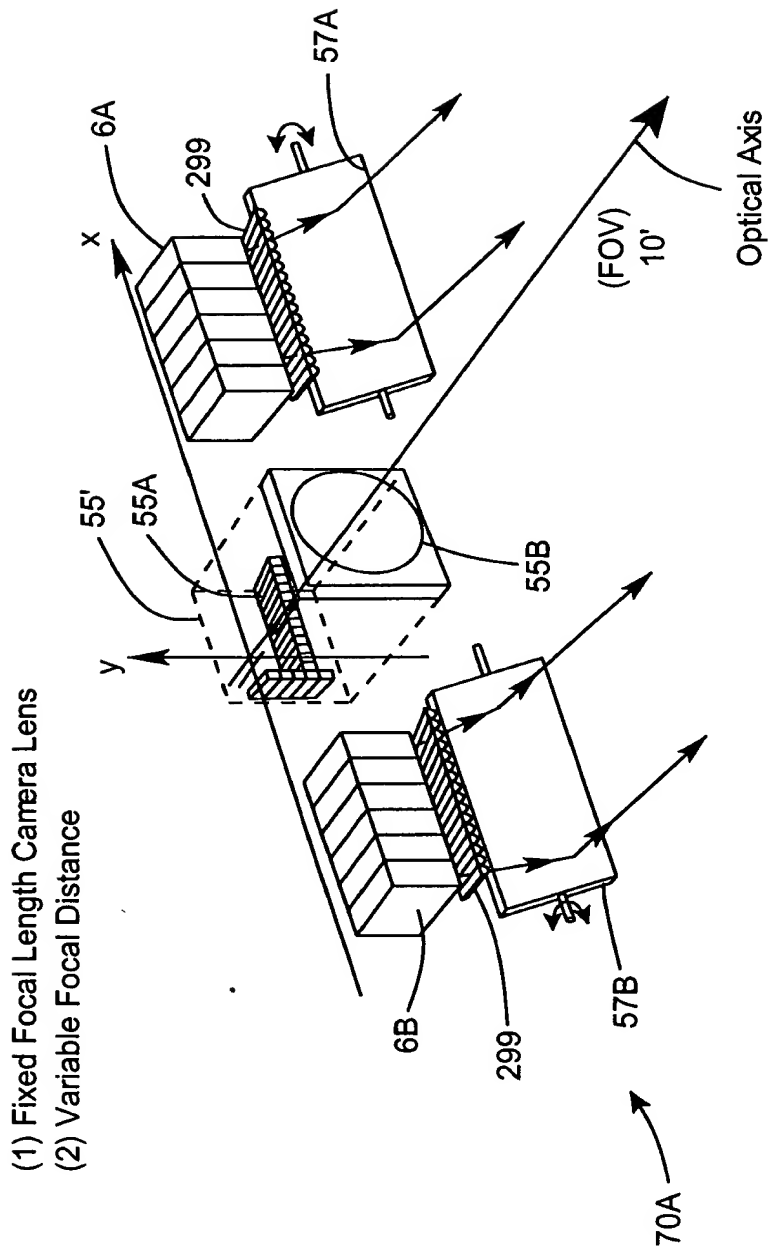


FIG. 5B2

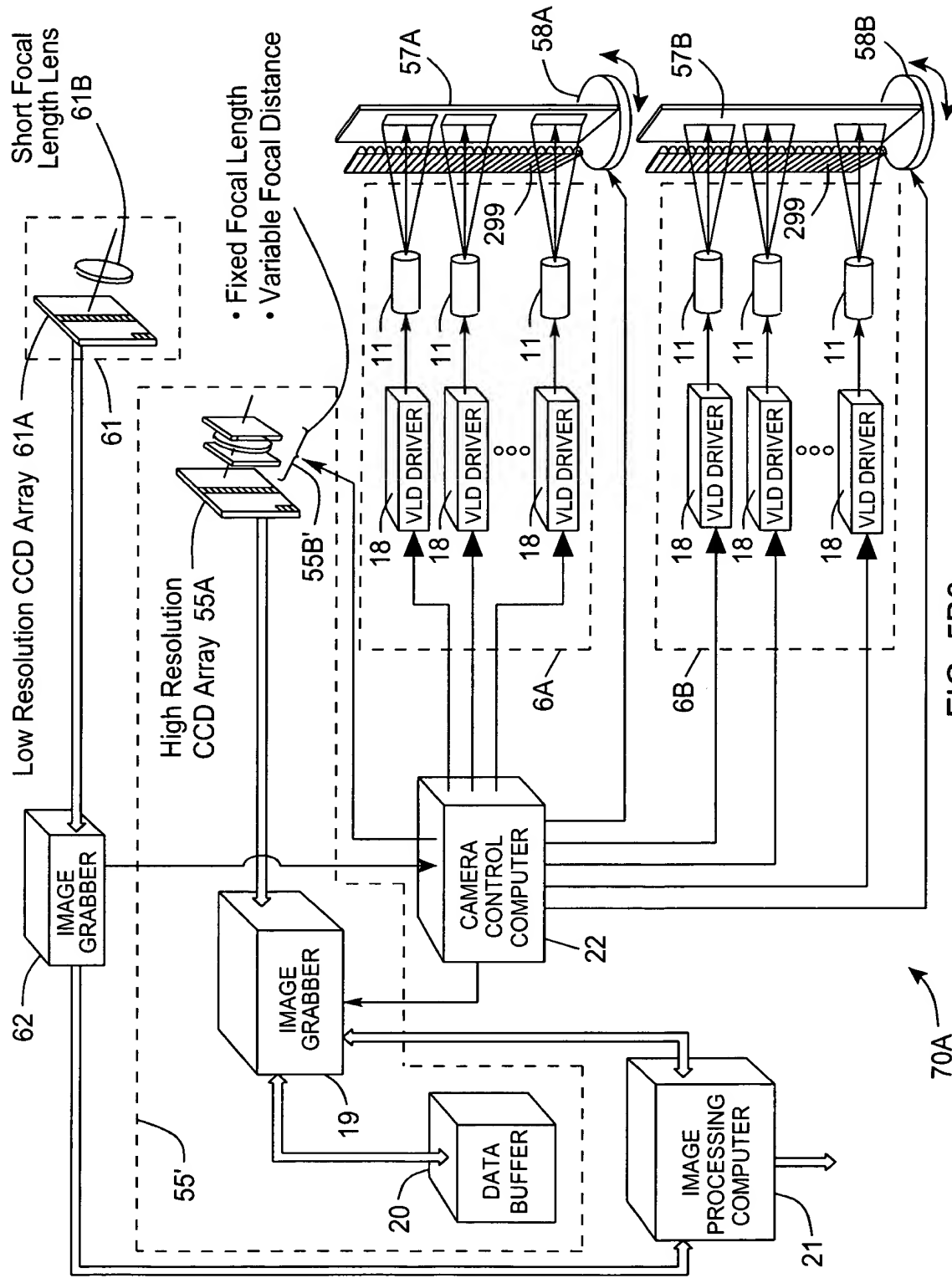


FIG. 5B3

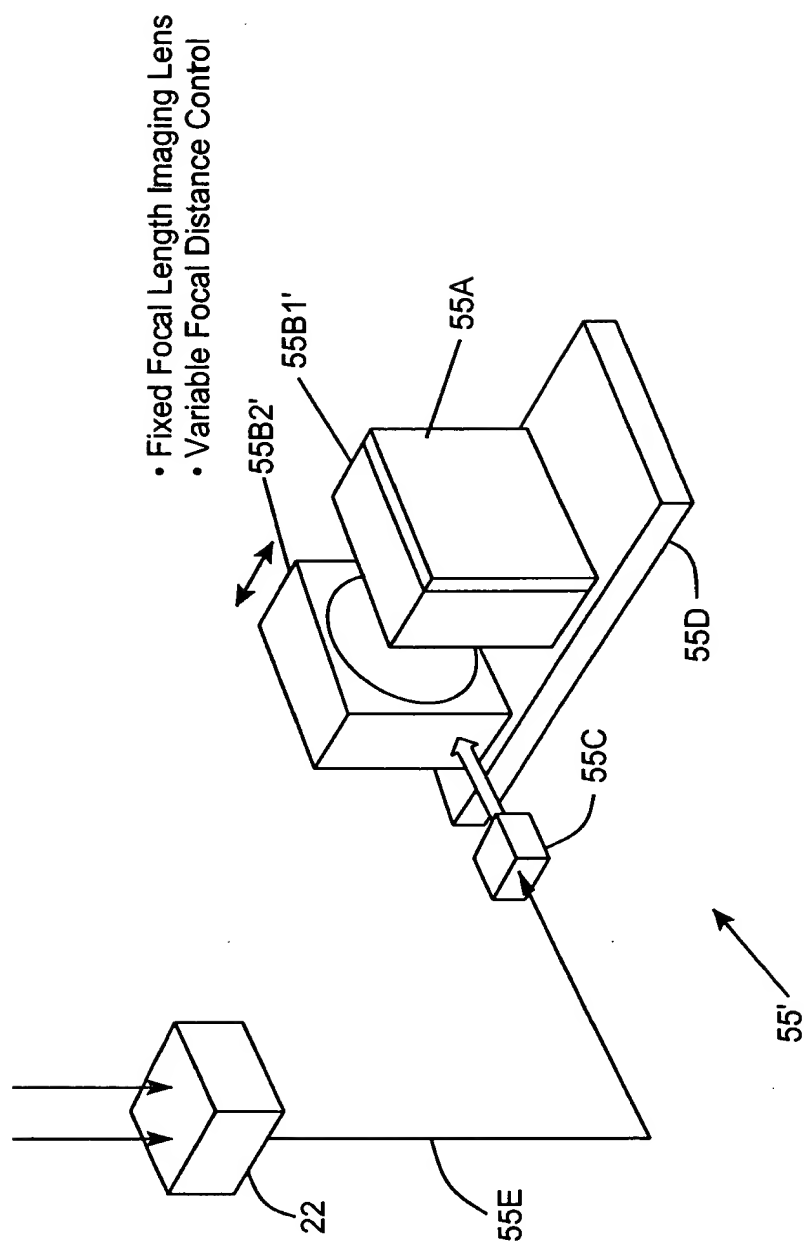


FIG. 5B4

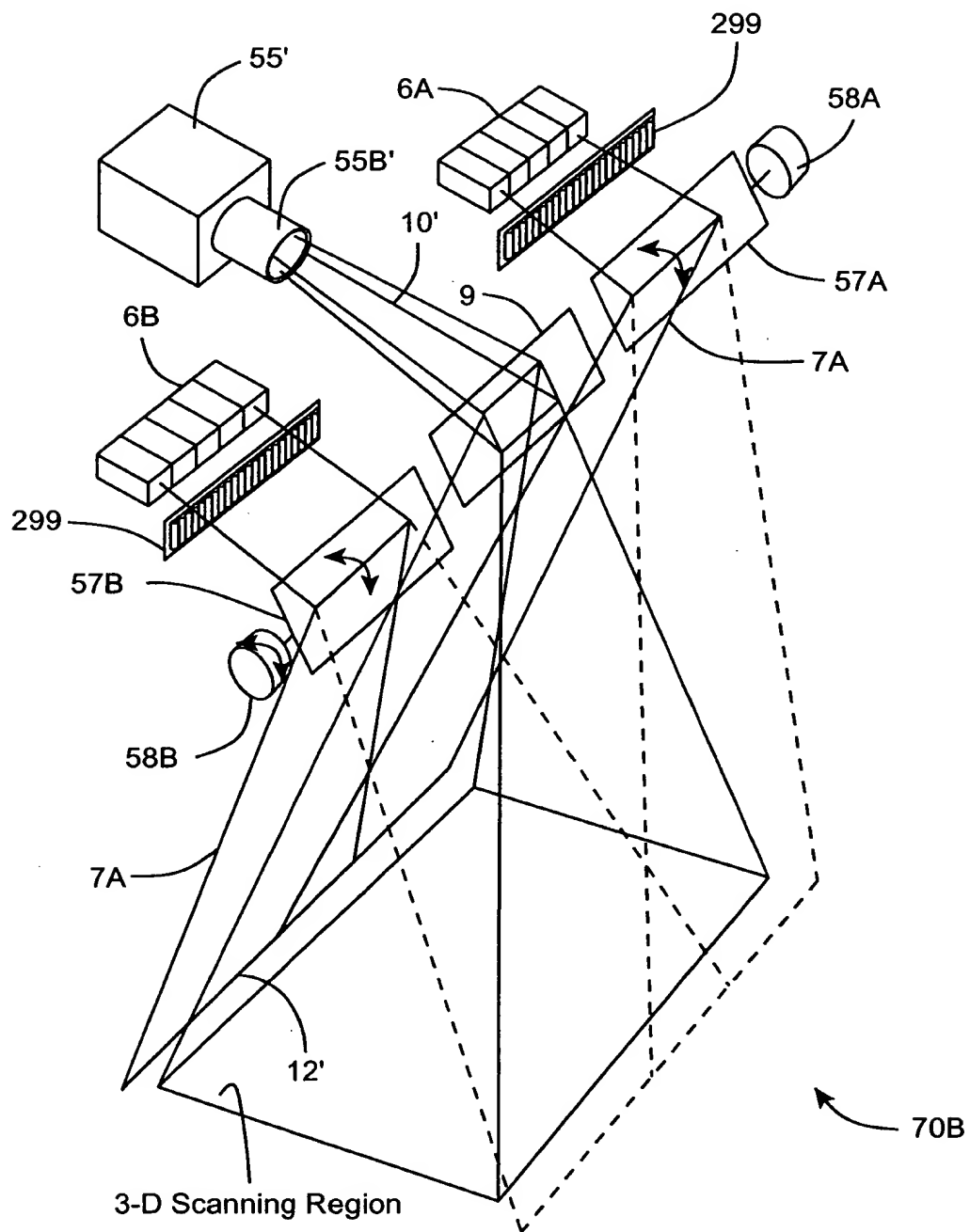
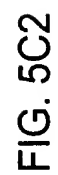


FIG. 5C1



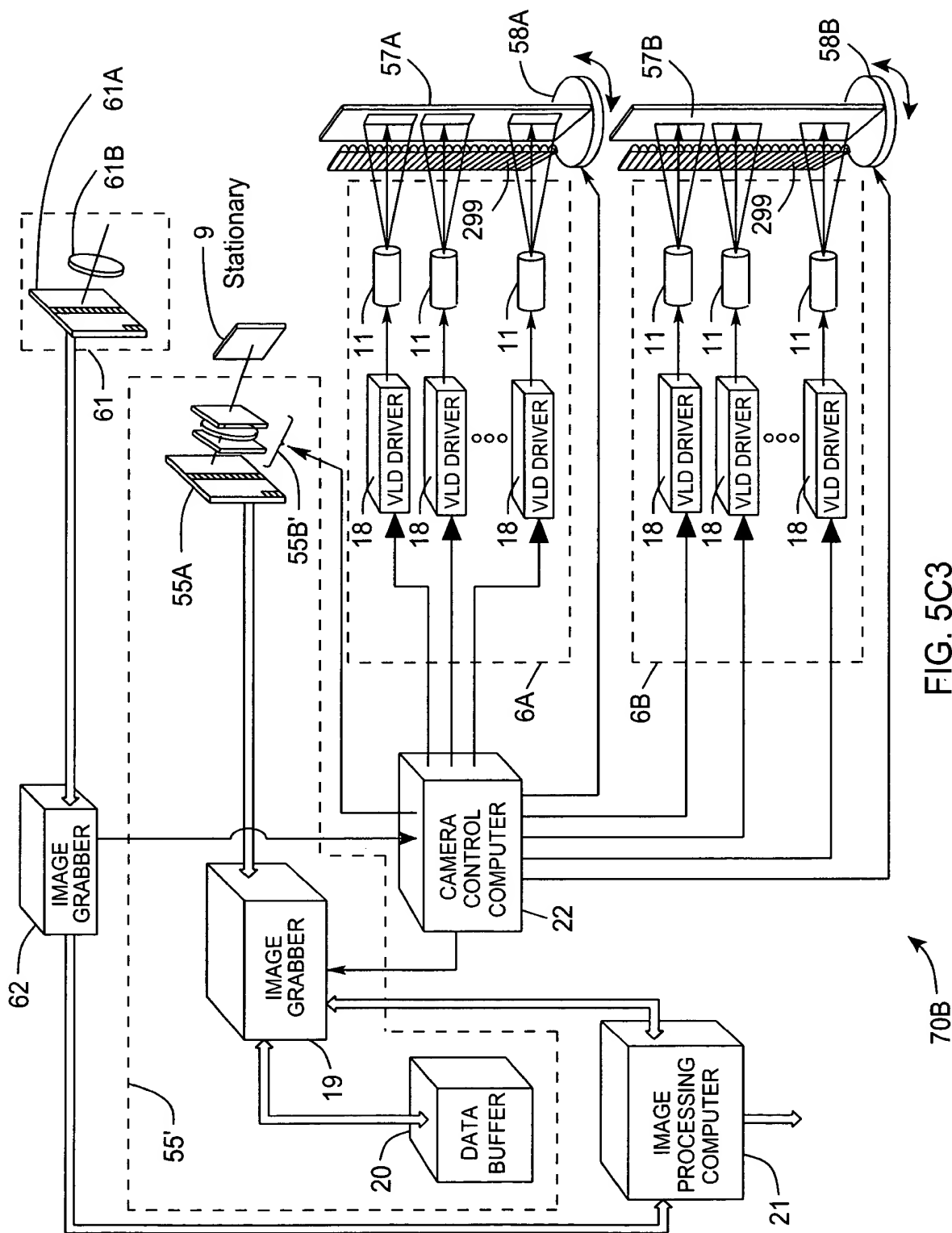


FIG. 5C3

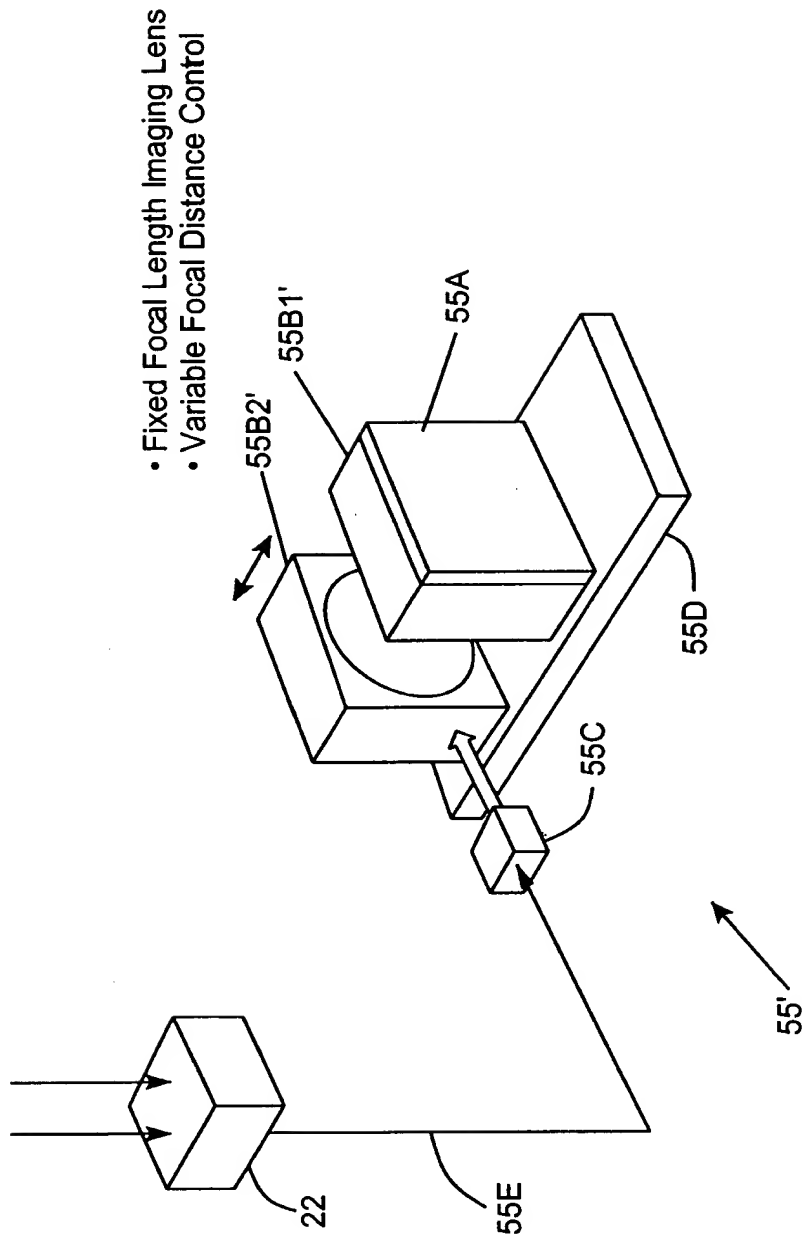


FIG. 5C4

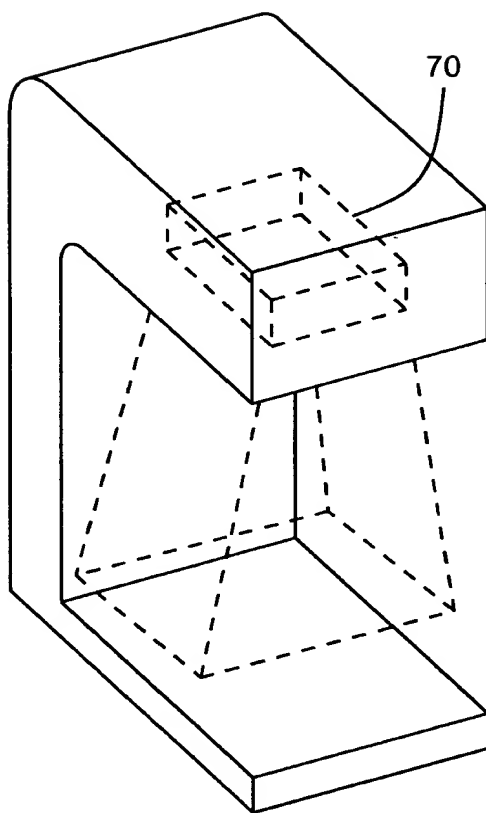


FIG. 5D

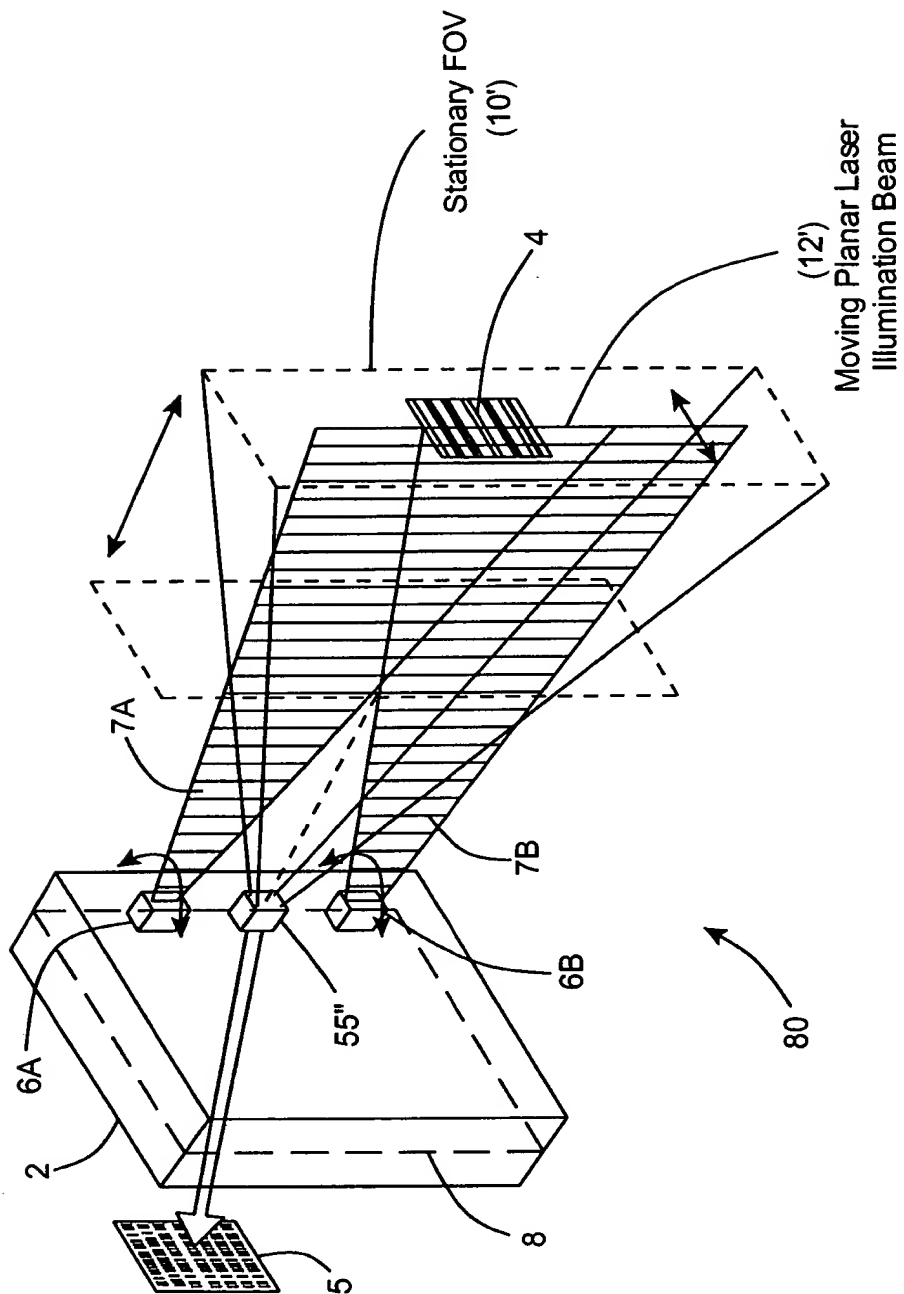


FIG. 6A

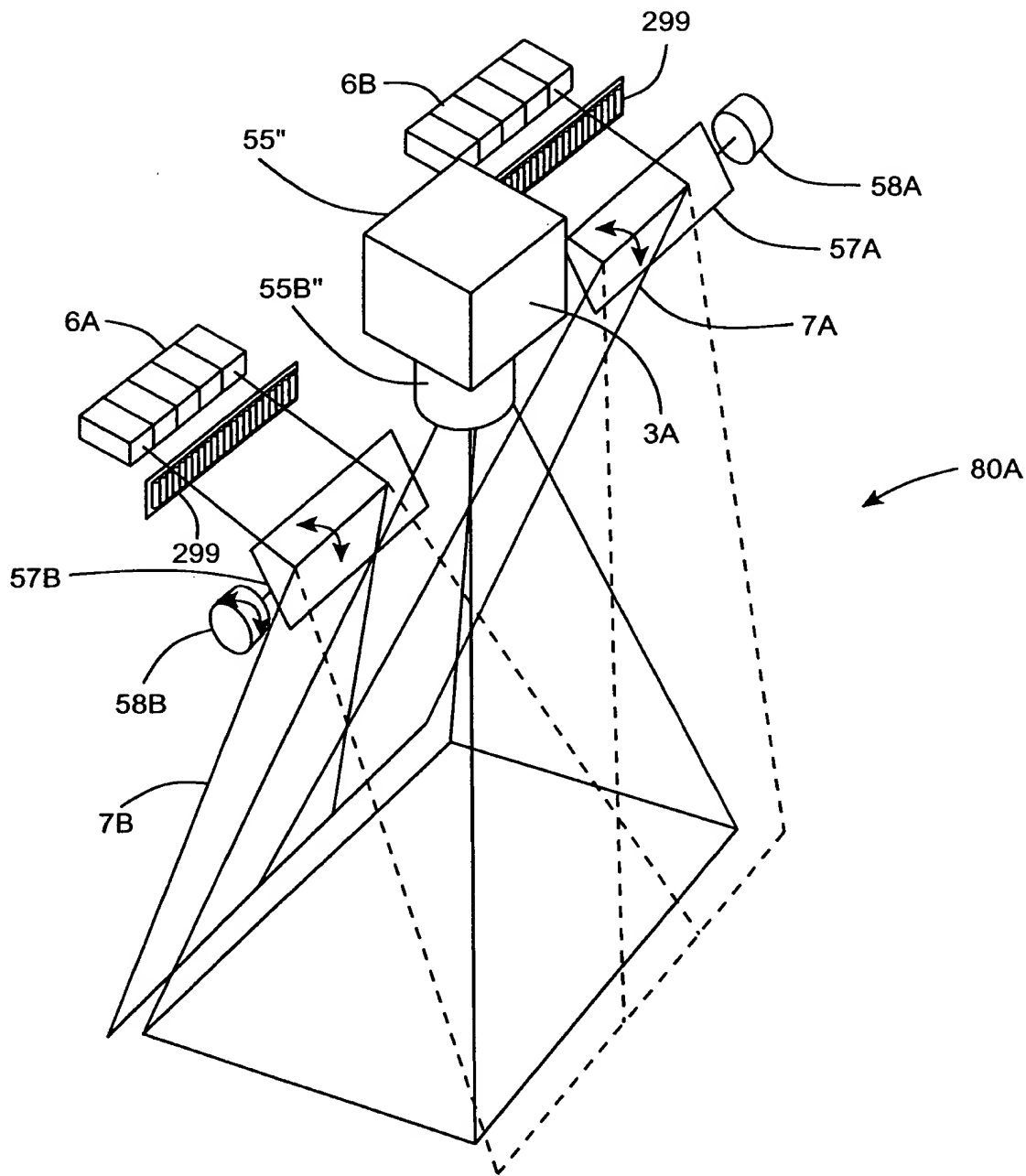


FIG. 6B1



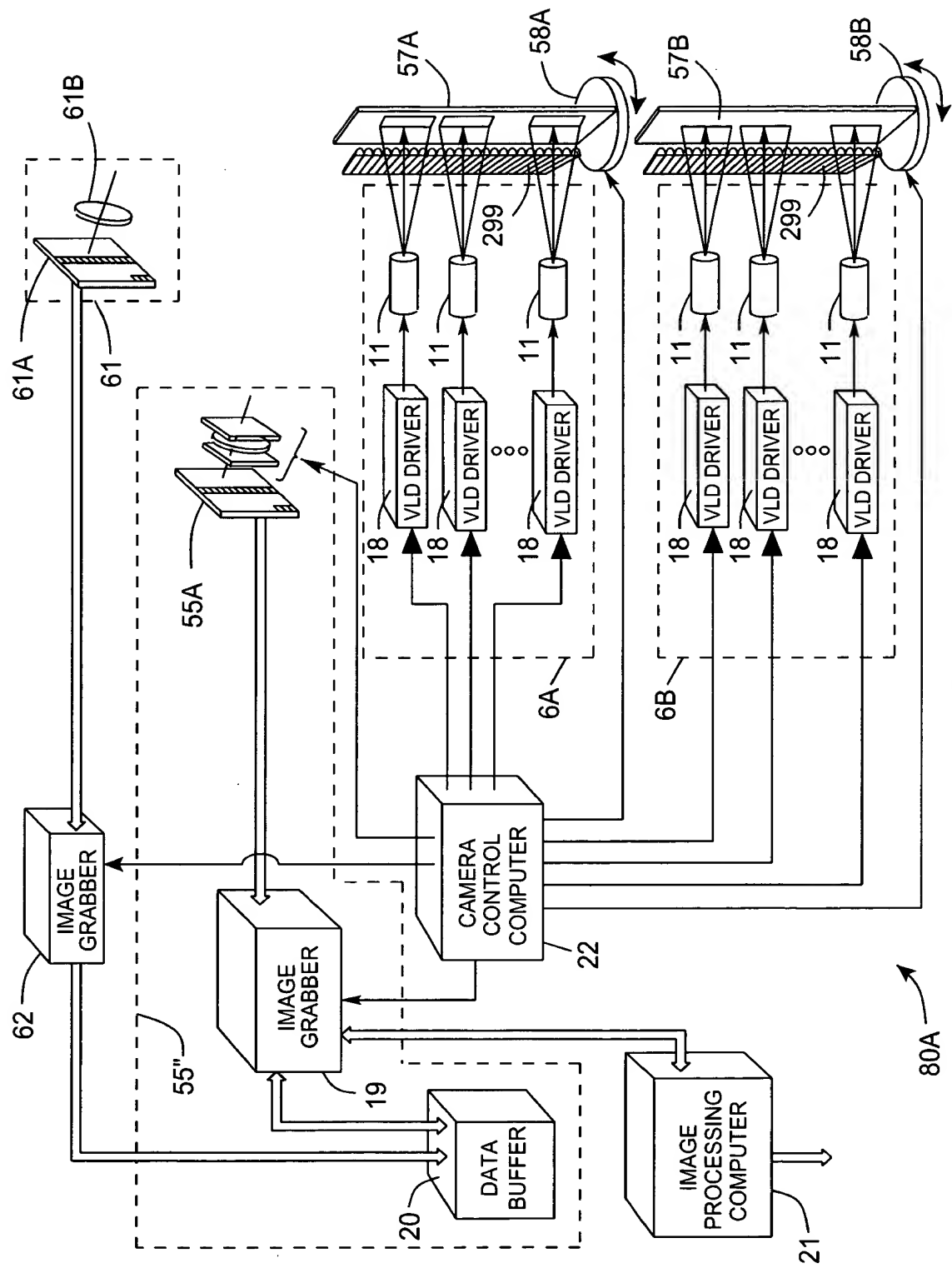


FIG. 6B3

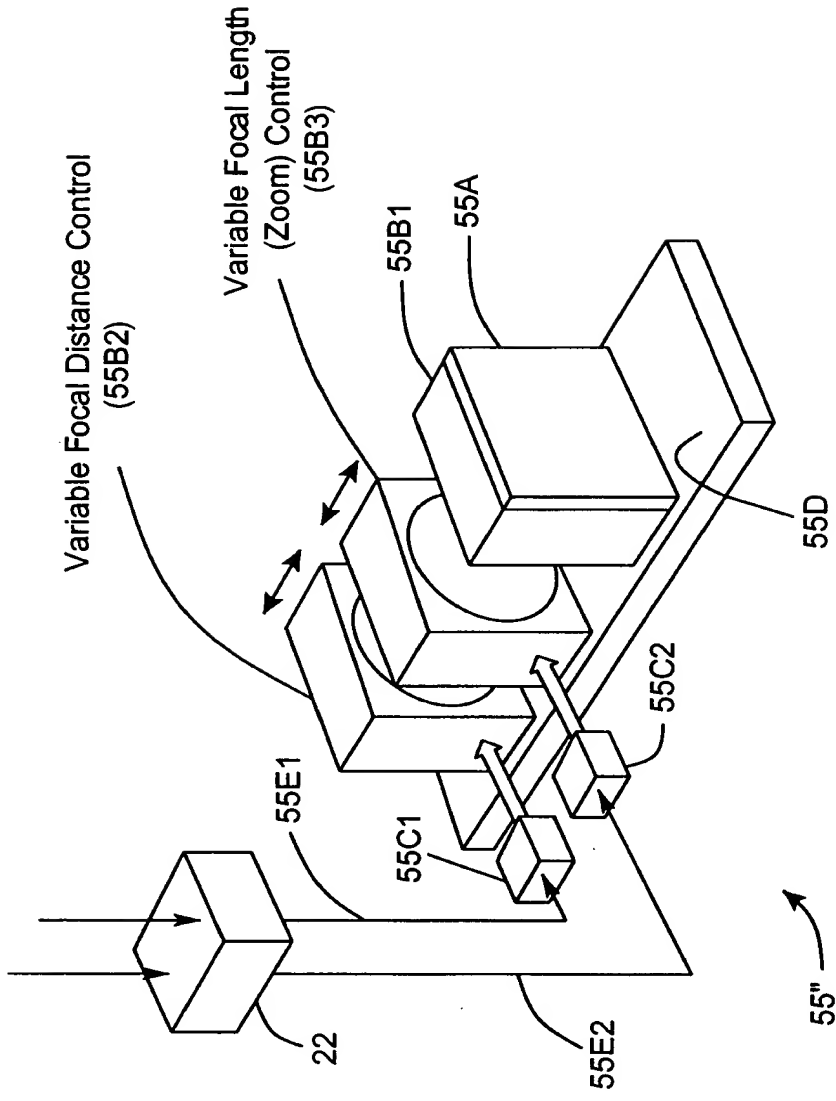


FIG. 6B4

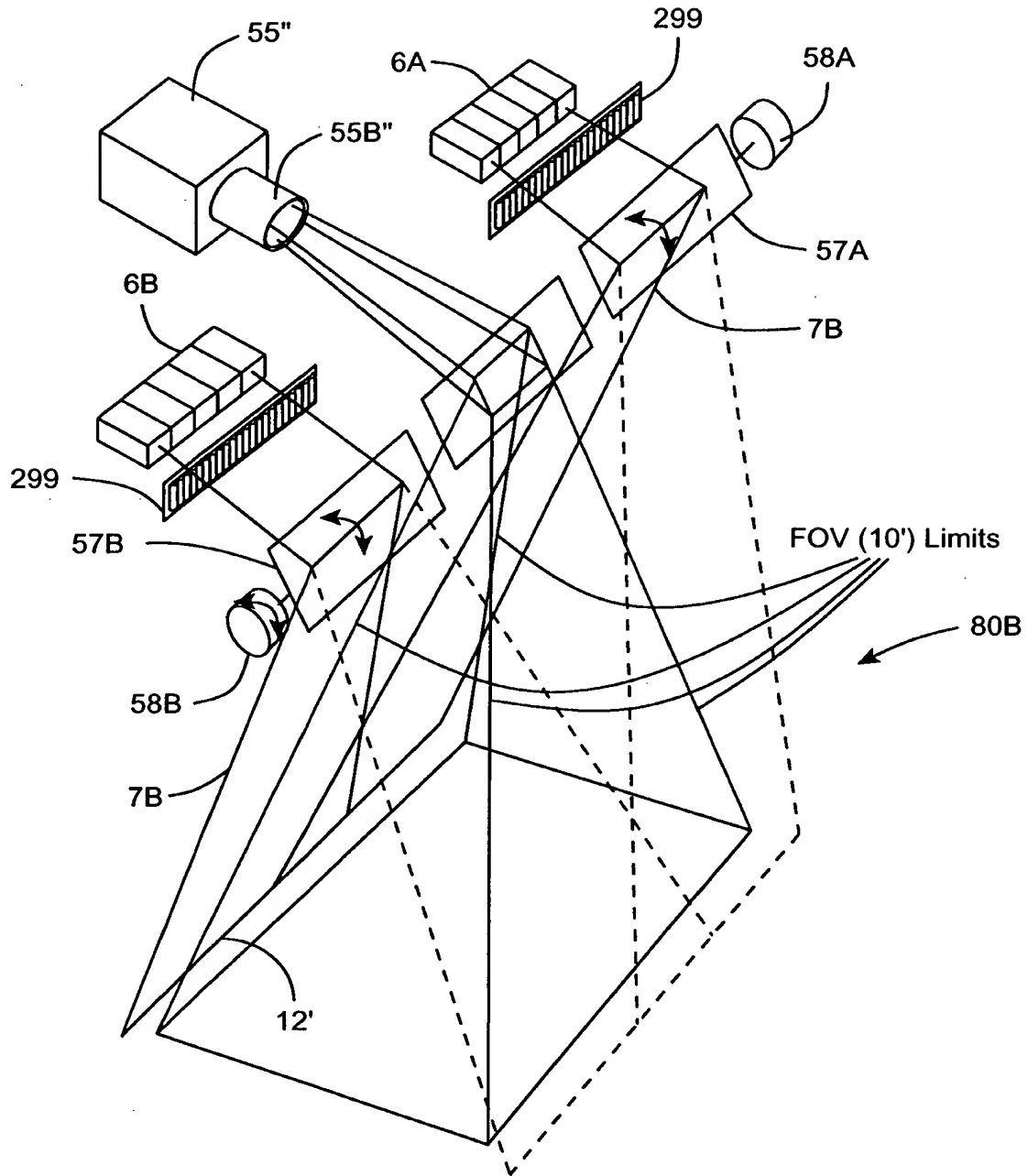


FIG. 6C1

- (1) Variable Focal Length Camera Lens
- (2) Variable Focal Distance

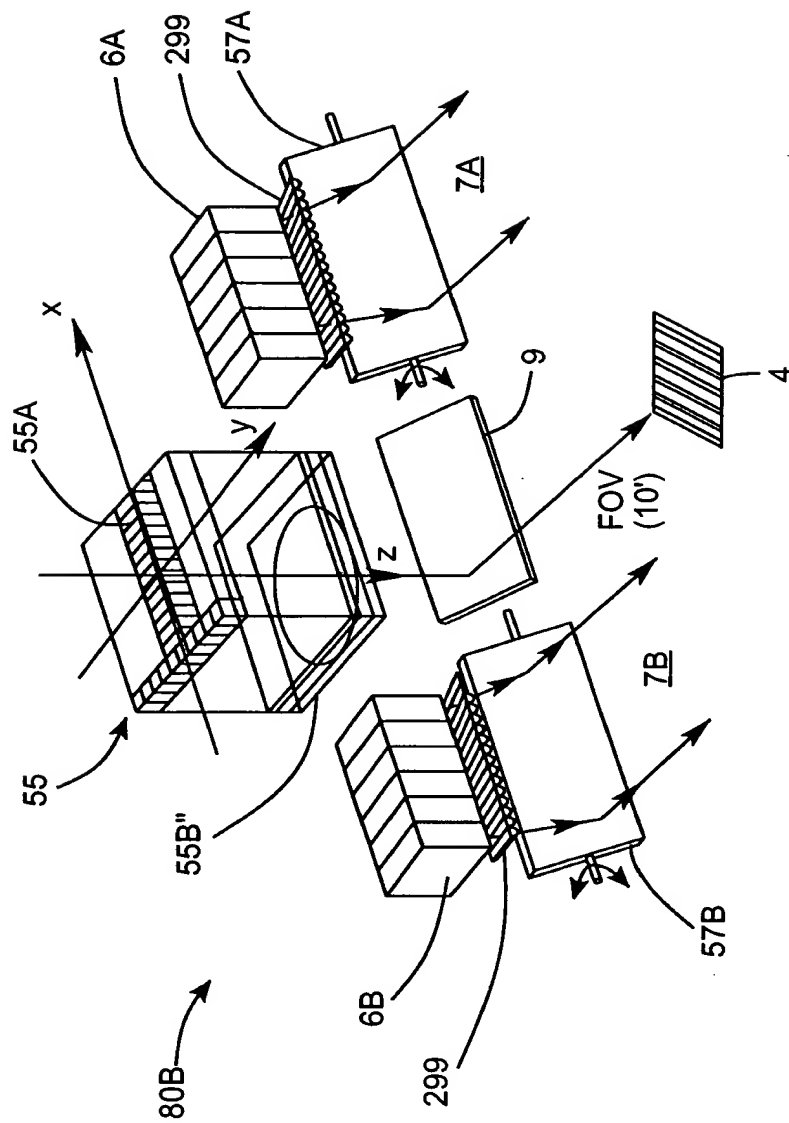


FIG. 6C2

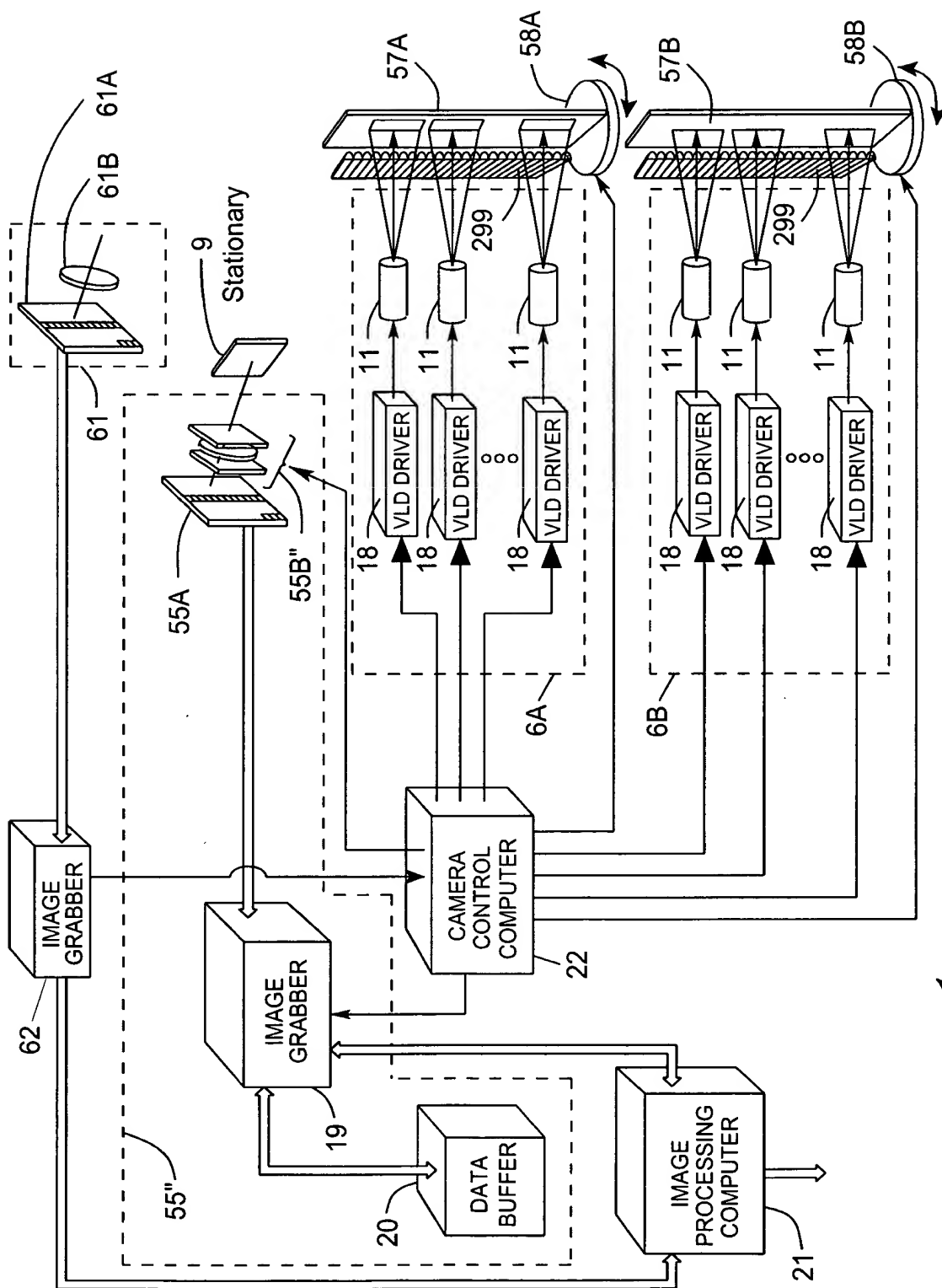


FIG. 6C3

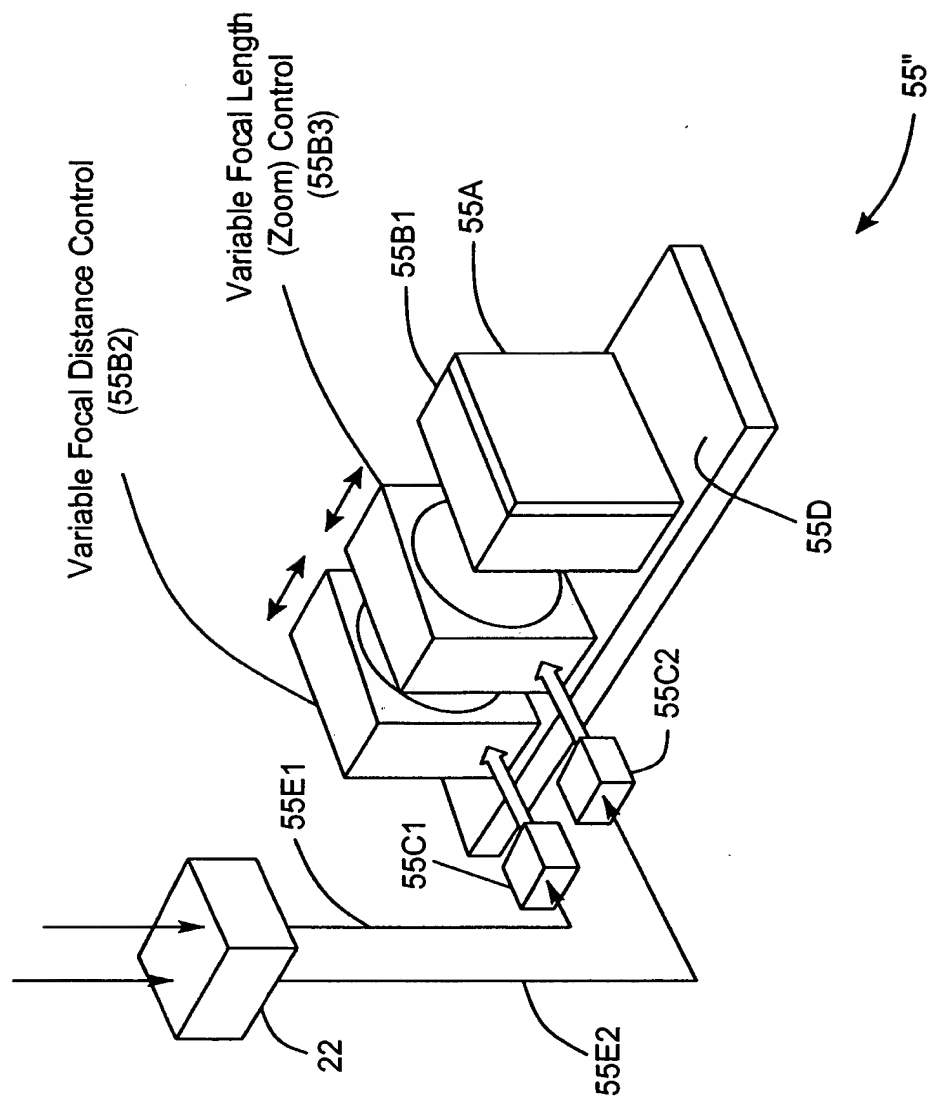


FIG. 6C4

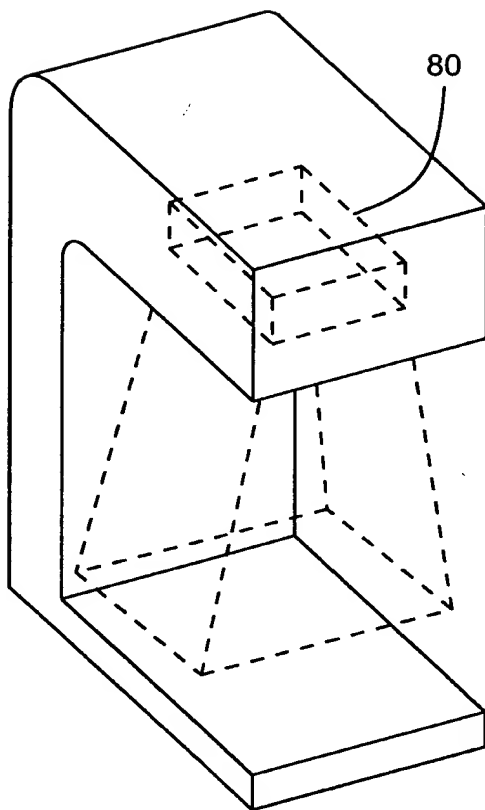


FIG. 6C5

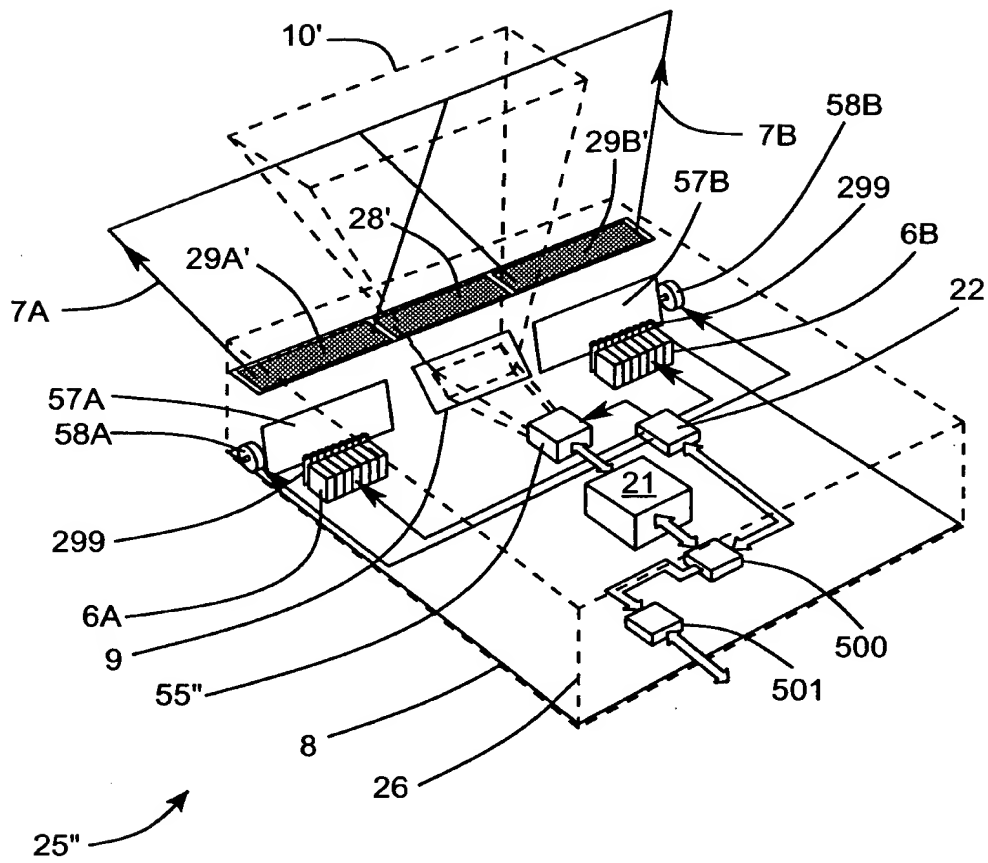


FIG. 6D1

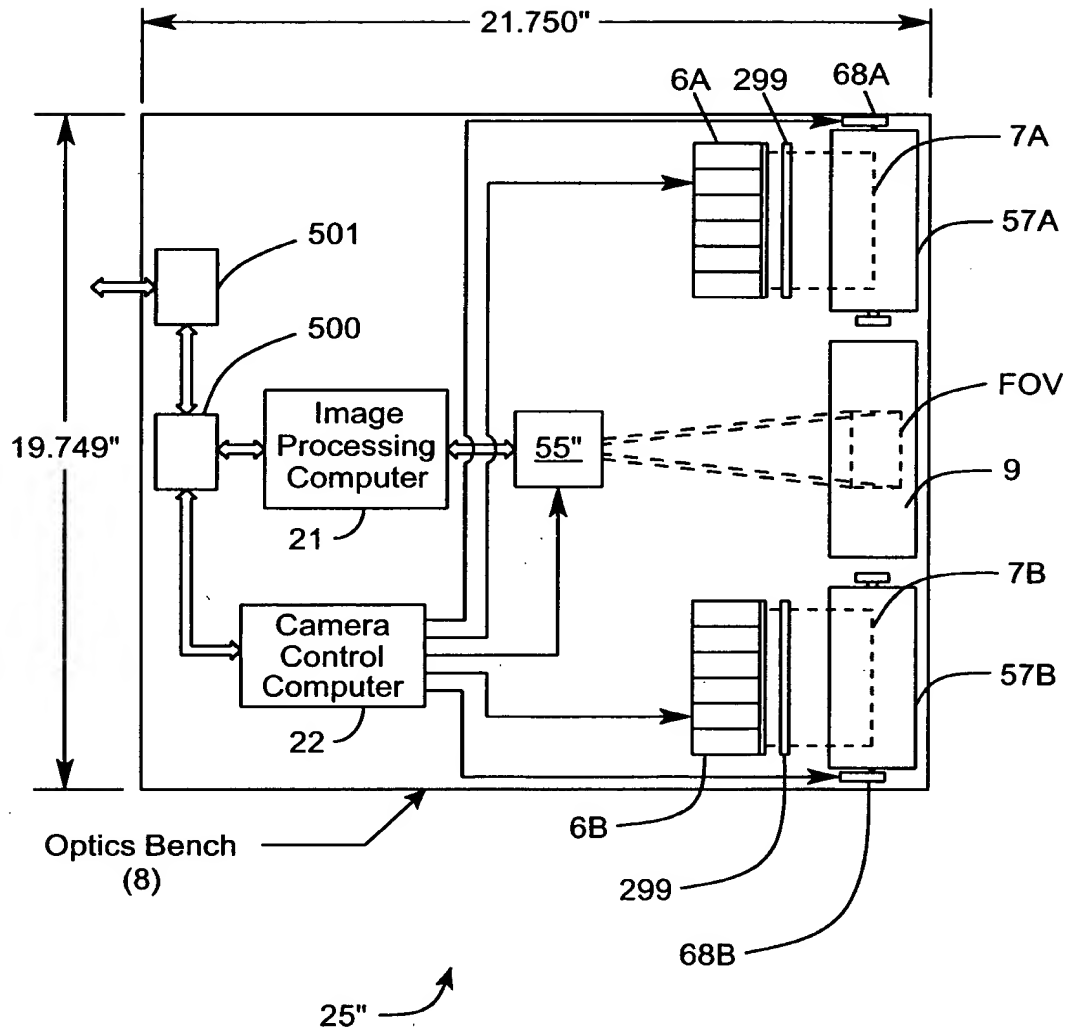


FIG. 6D2

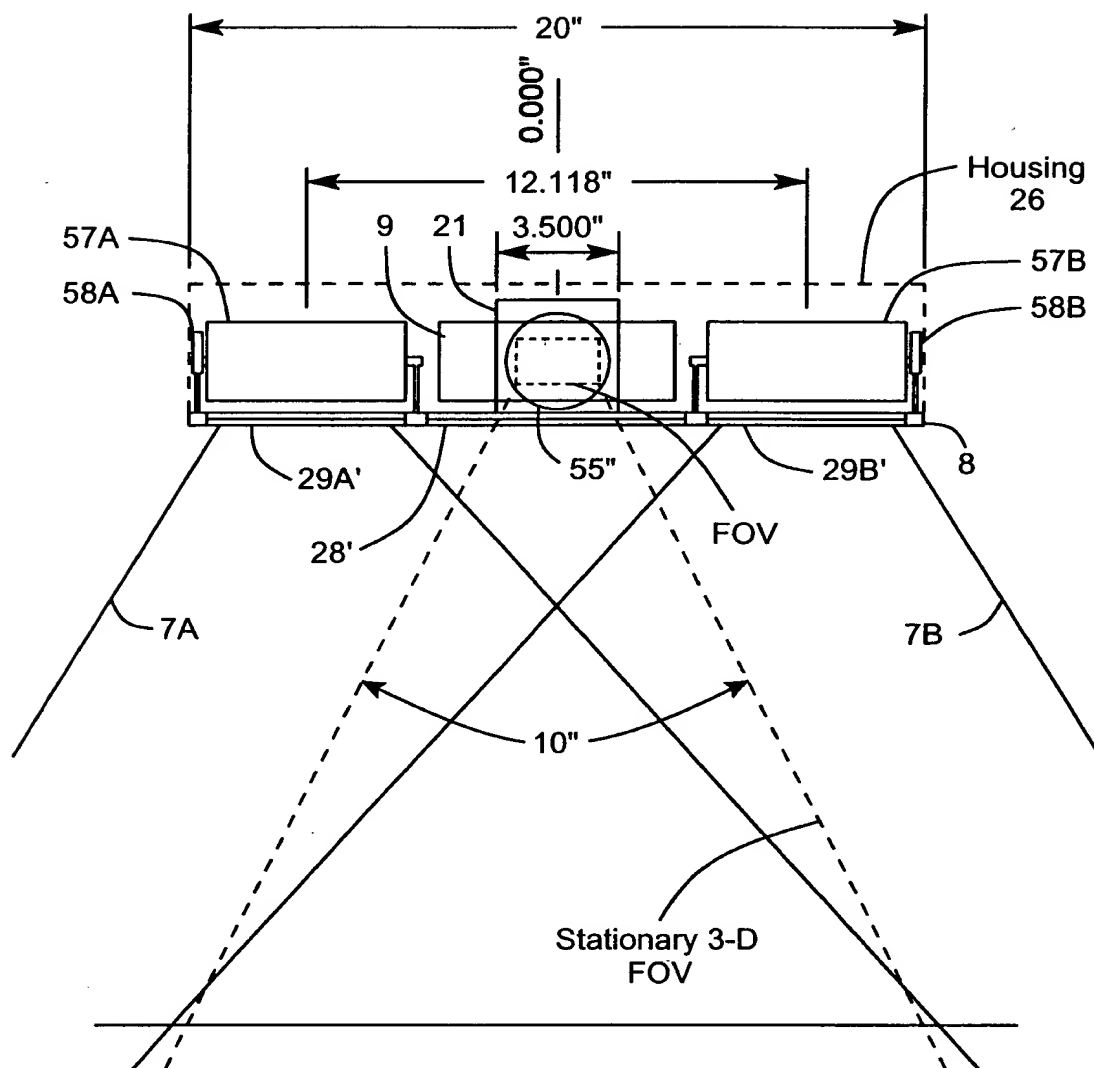
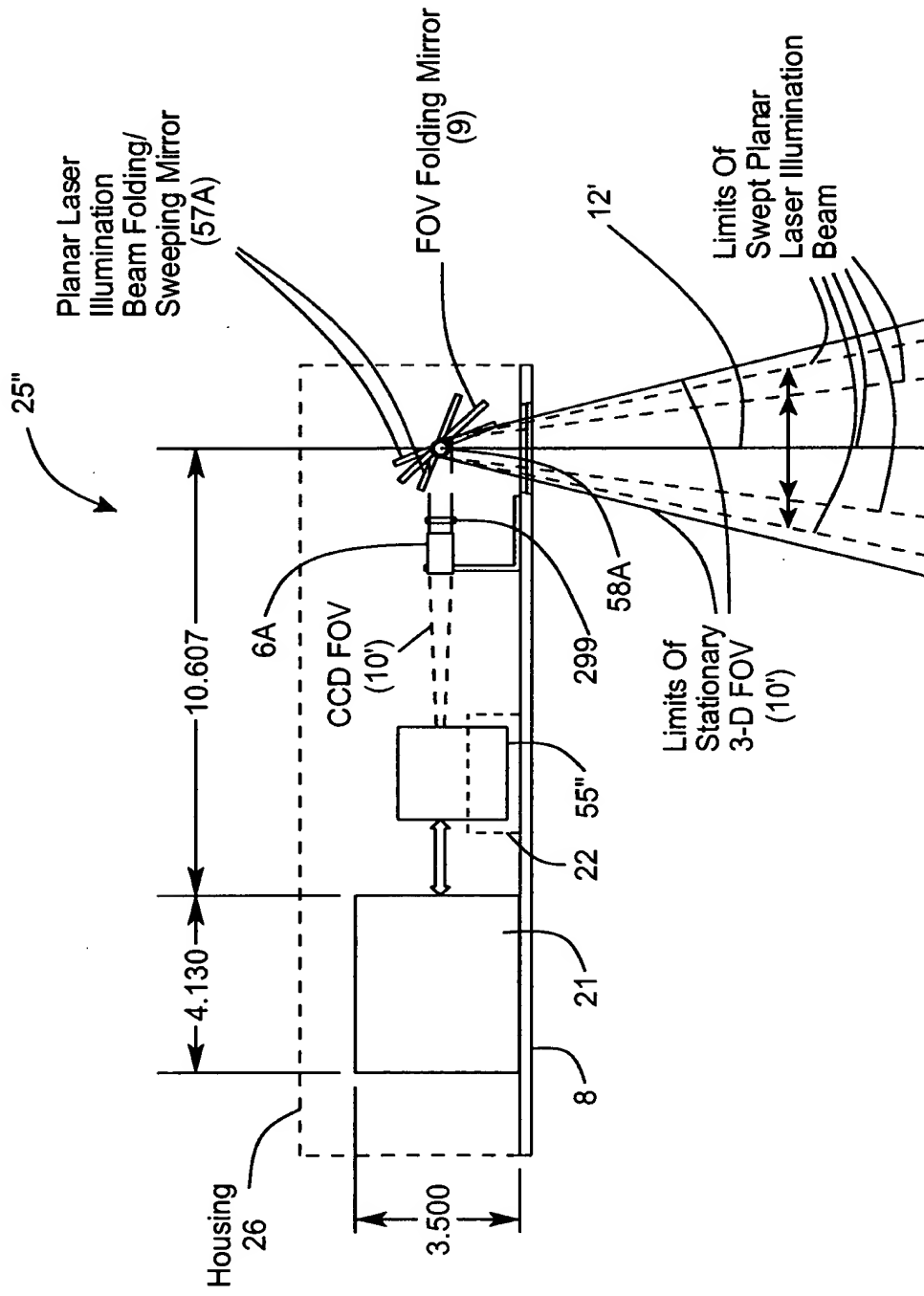


FIG. 6D3





* Variable FOV

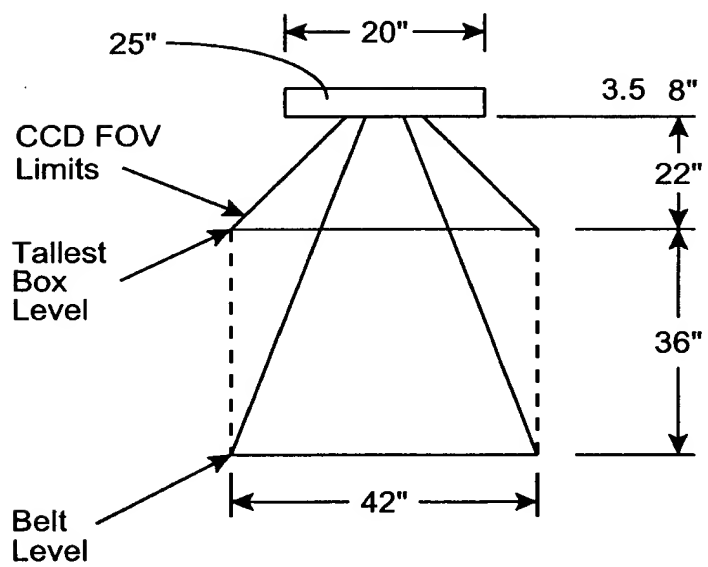


FIG. 6D5

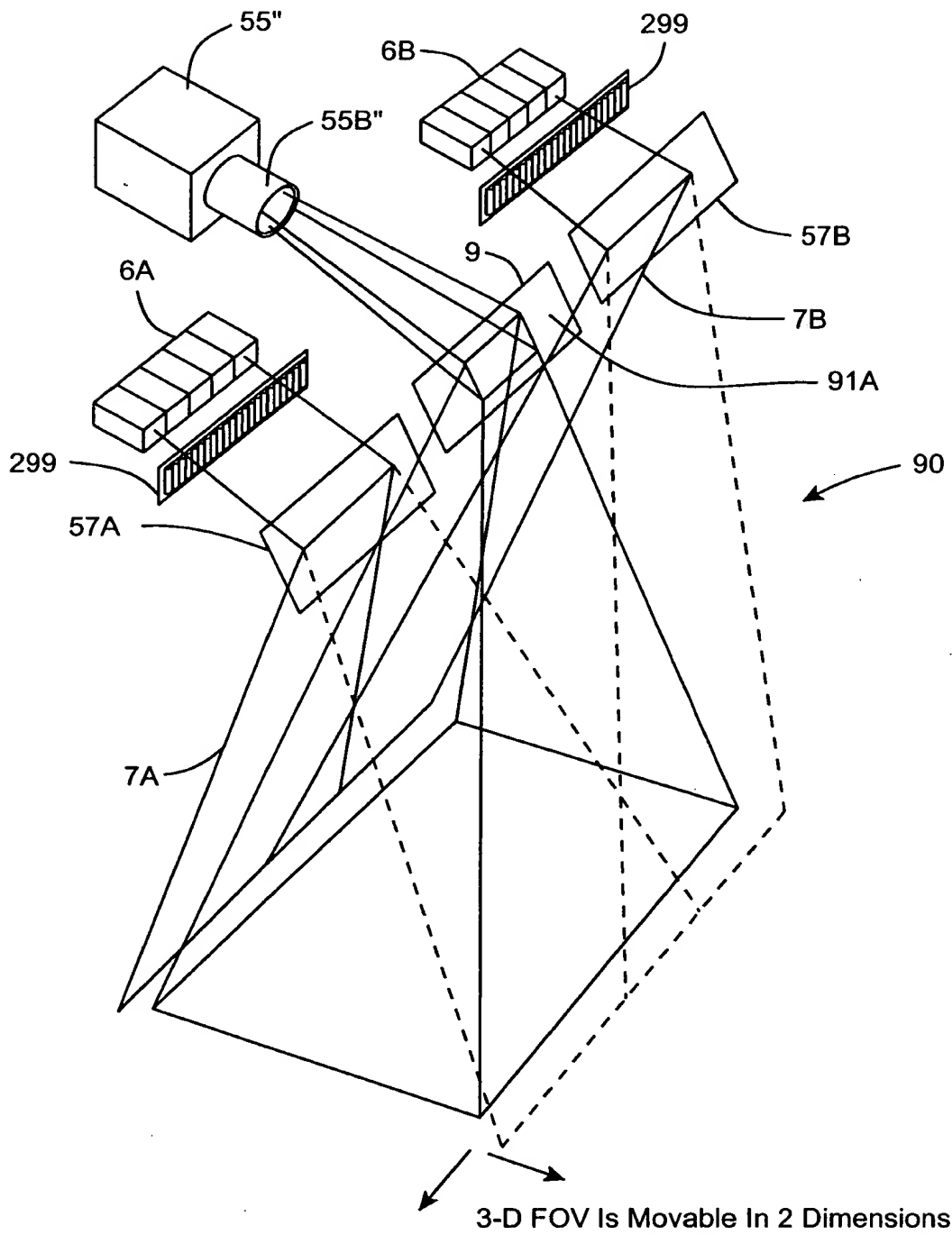
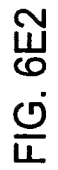
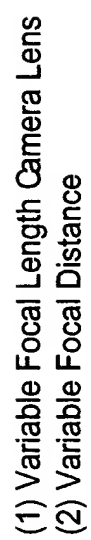


FIG. 6E1



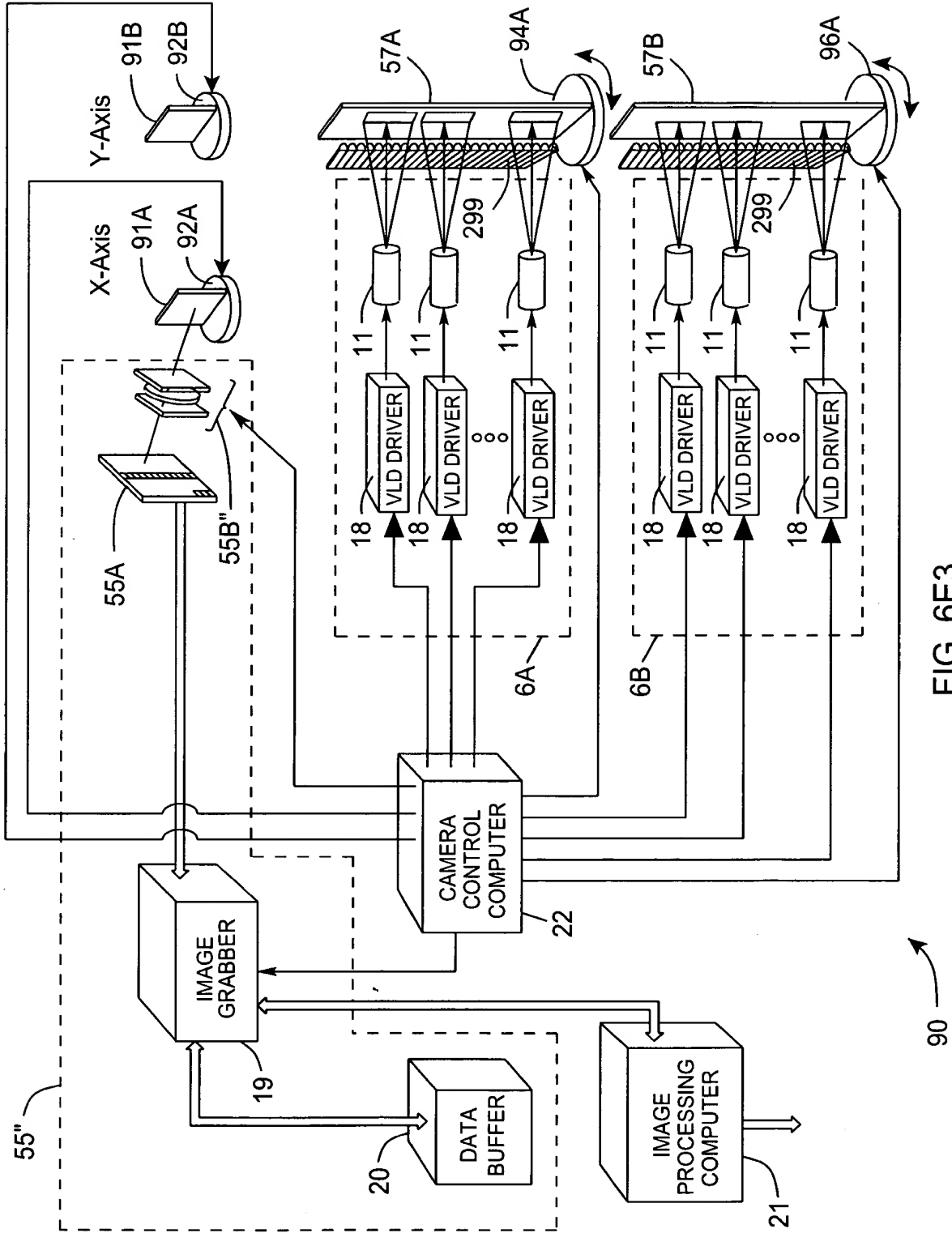


FIG. 6E3

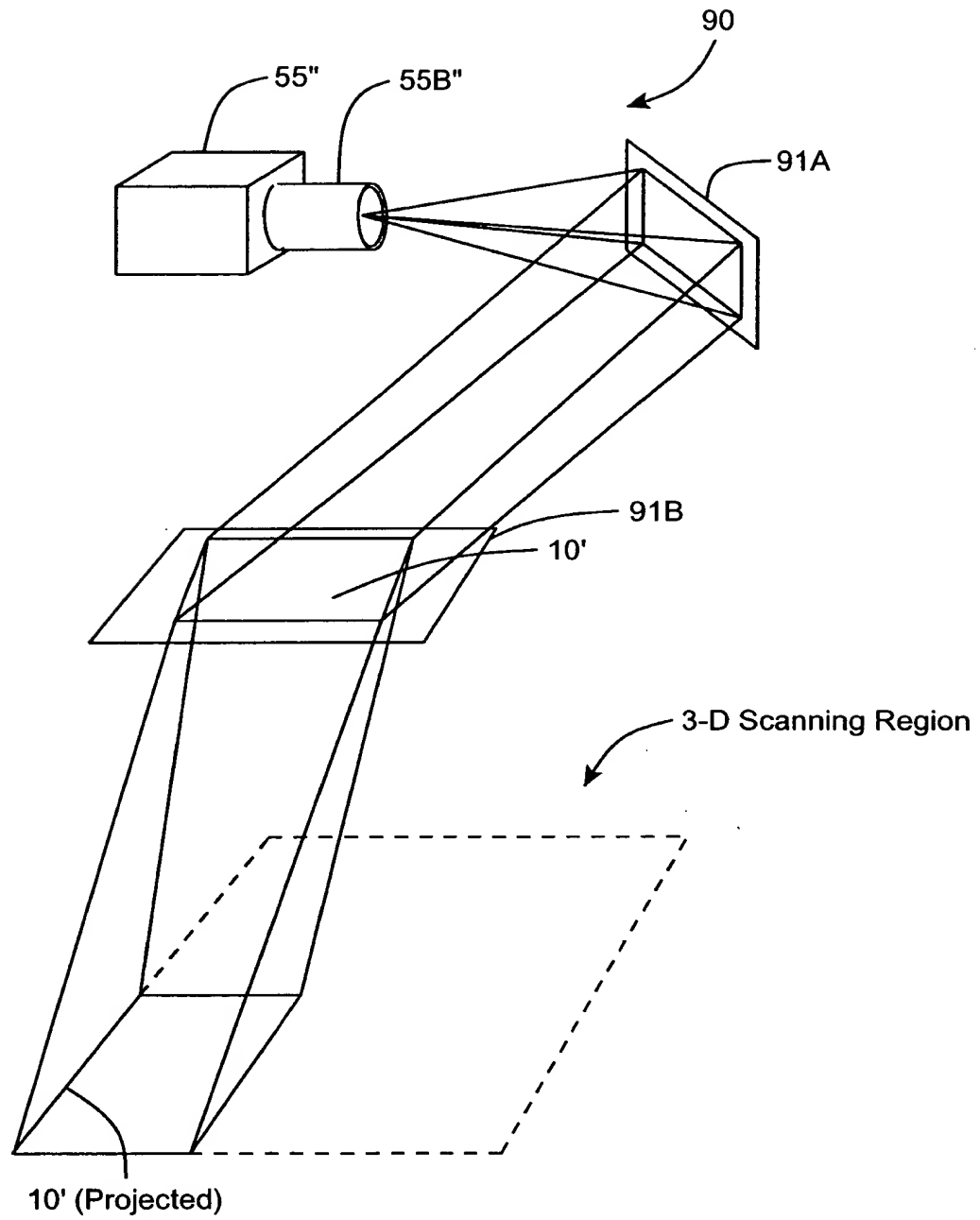
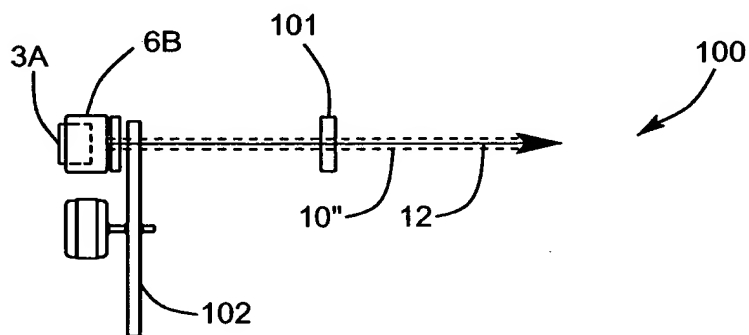
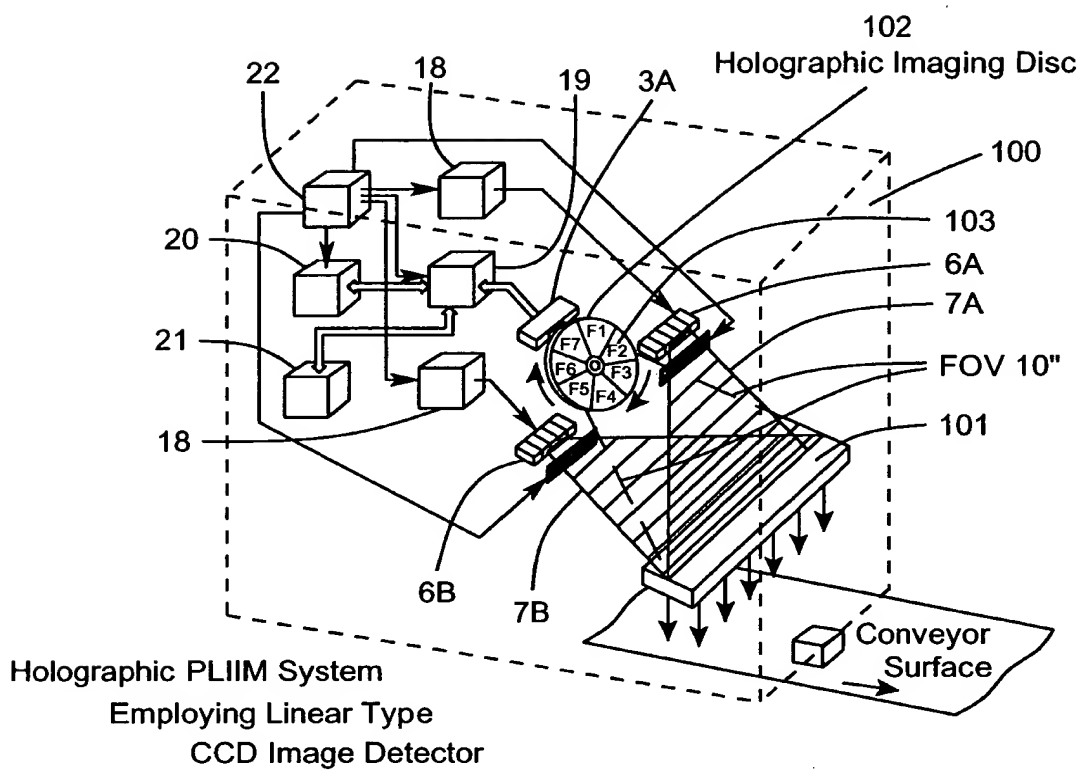


FIG. 6E4



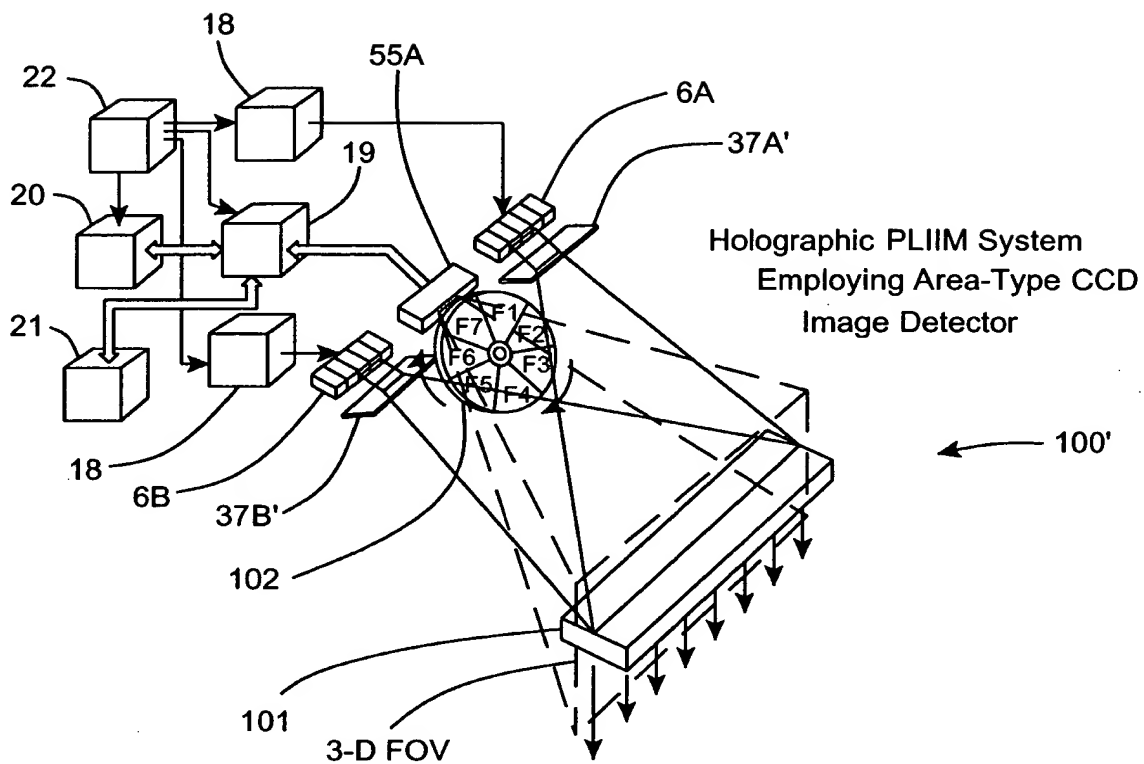


FIG. 8A

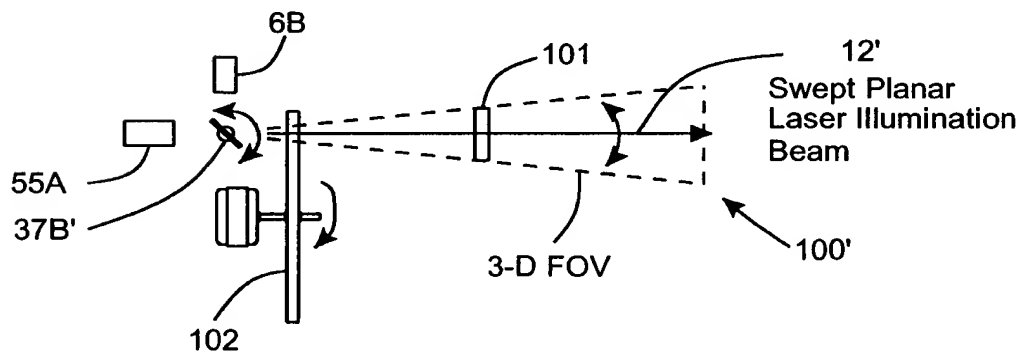


FIG. 8B

1-D Scanner Embodiment

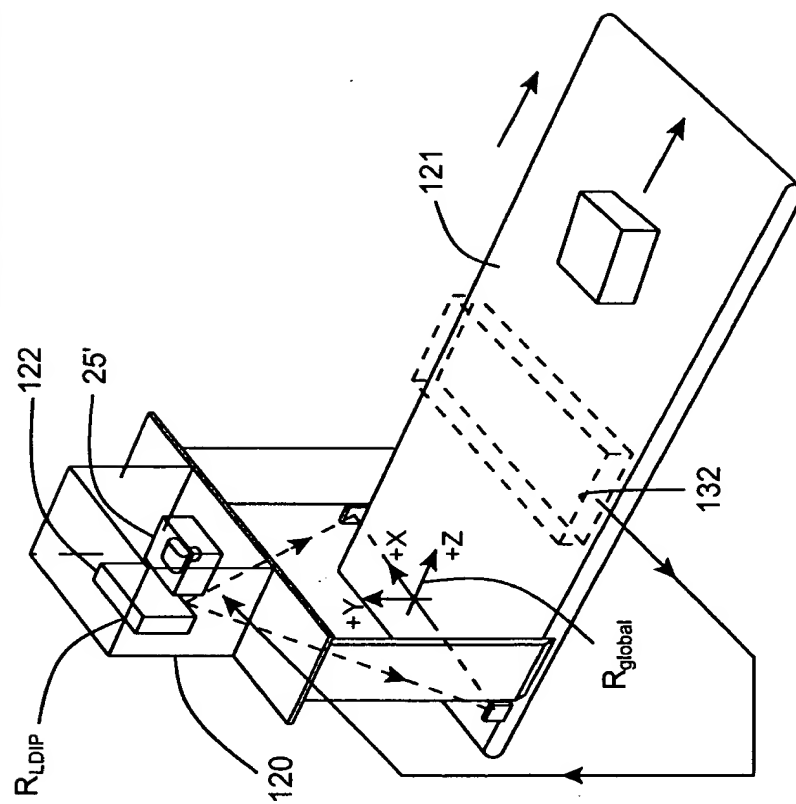


FIG. 9

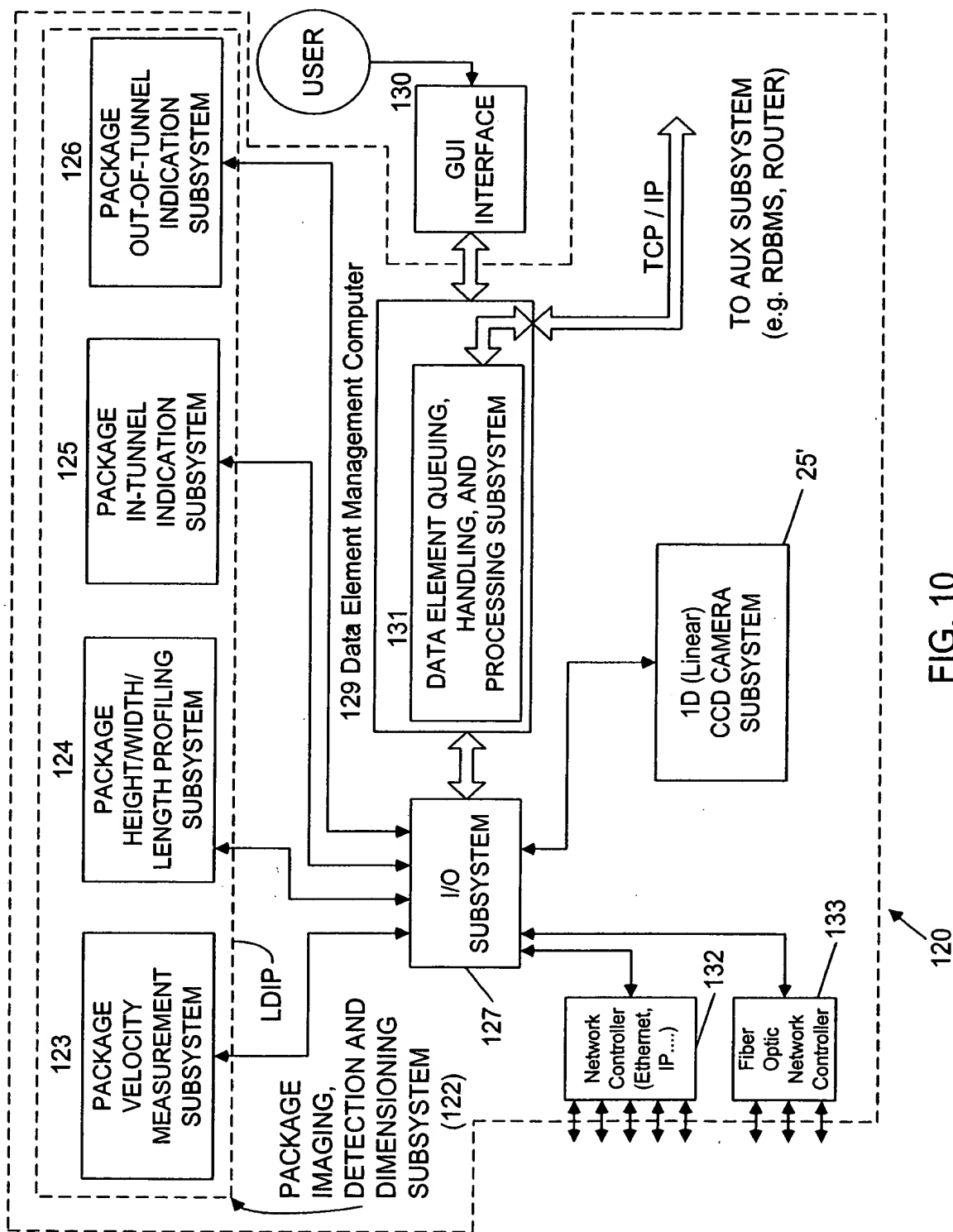


FIG. 10

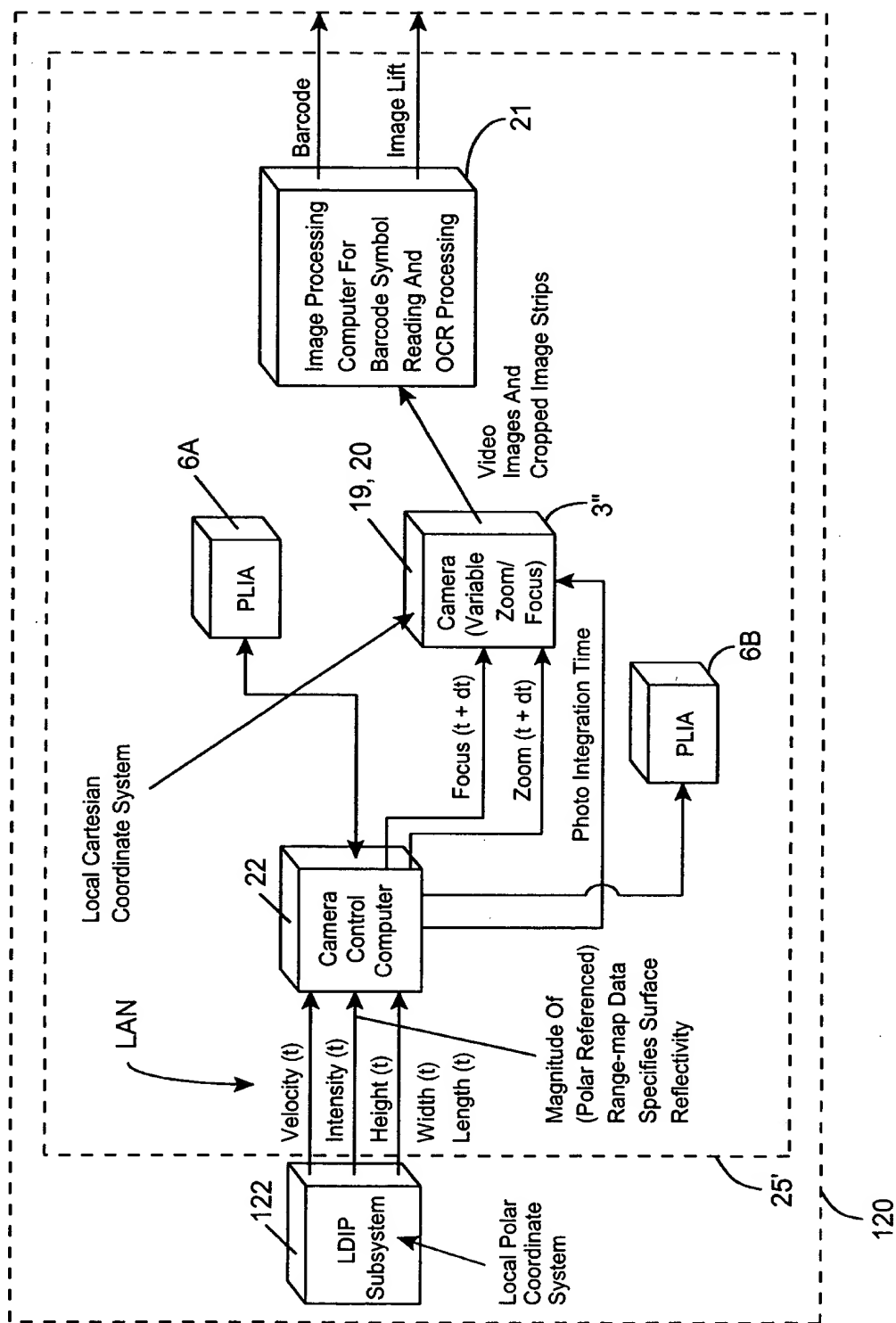


FIG. 11

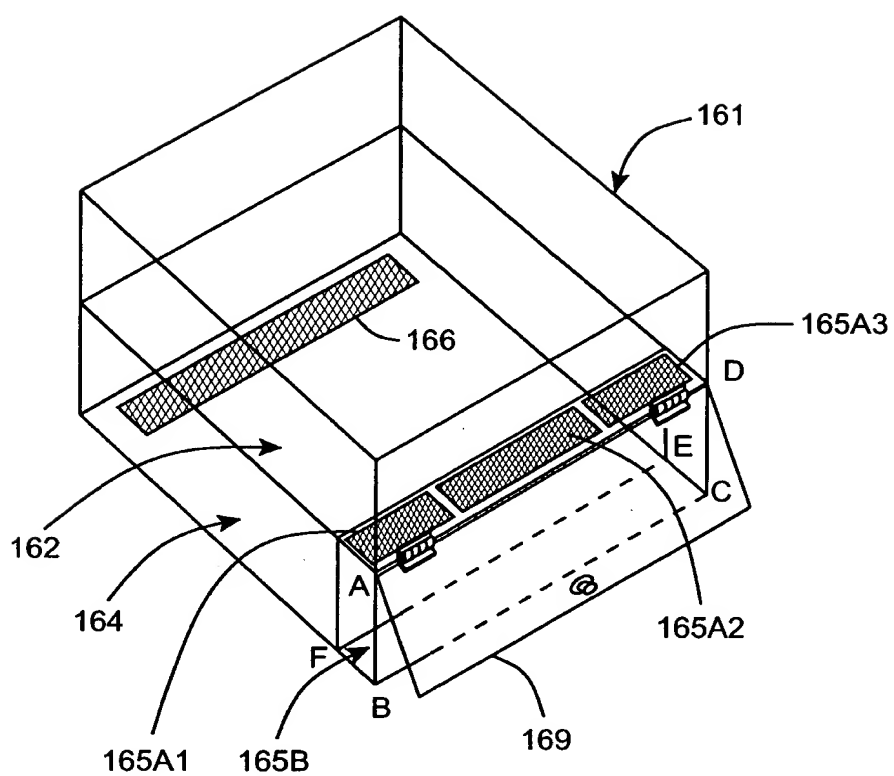


FIG. 12A

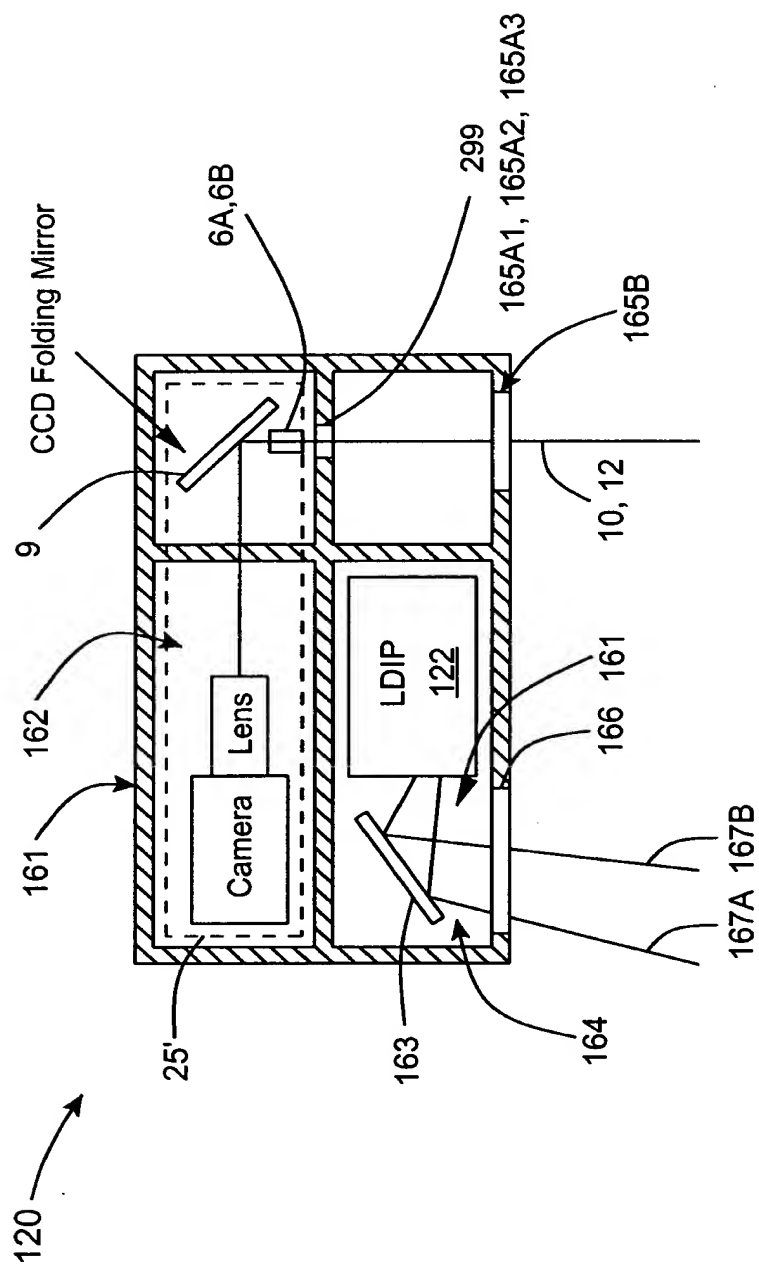


FIG. 12B

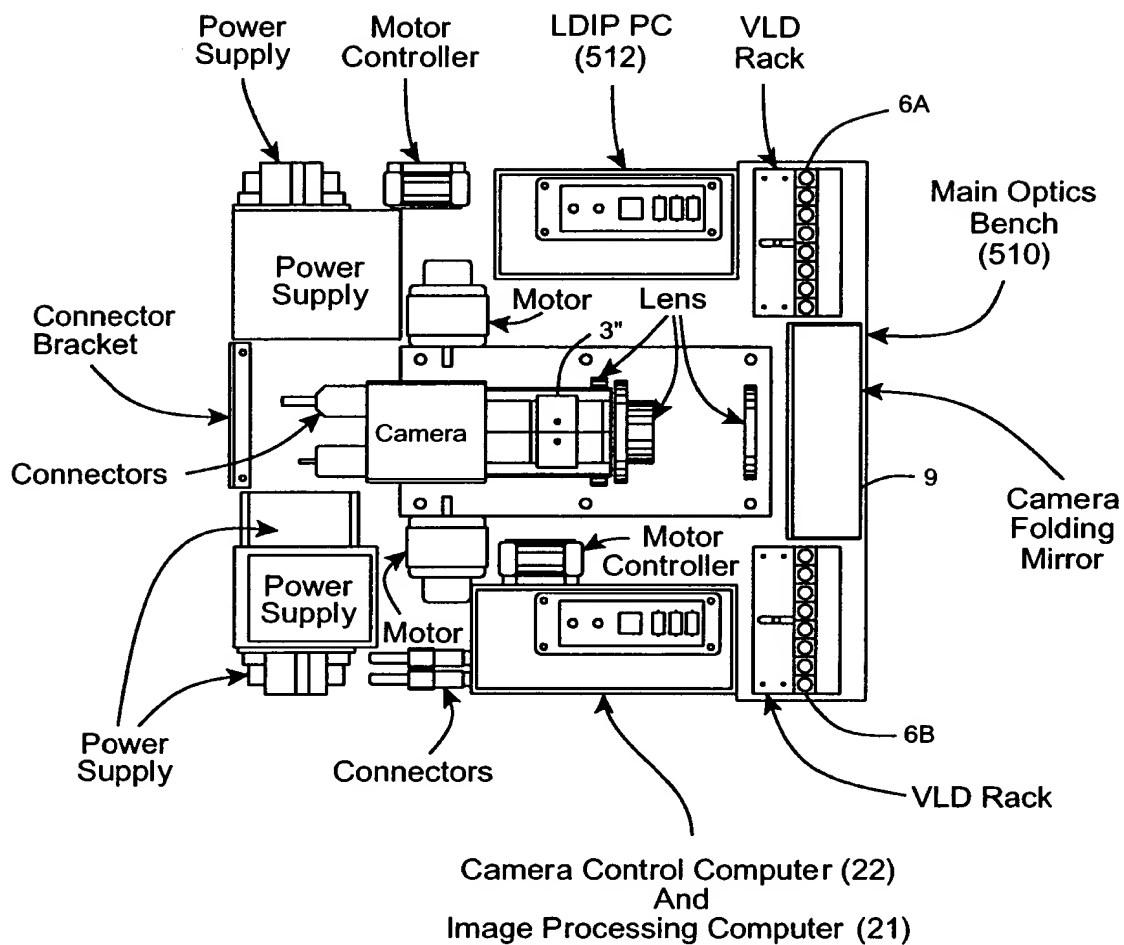


FIG. 12C

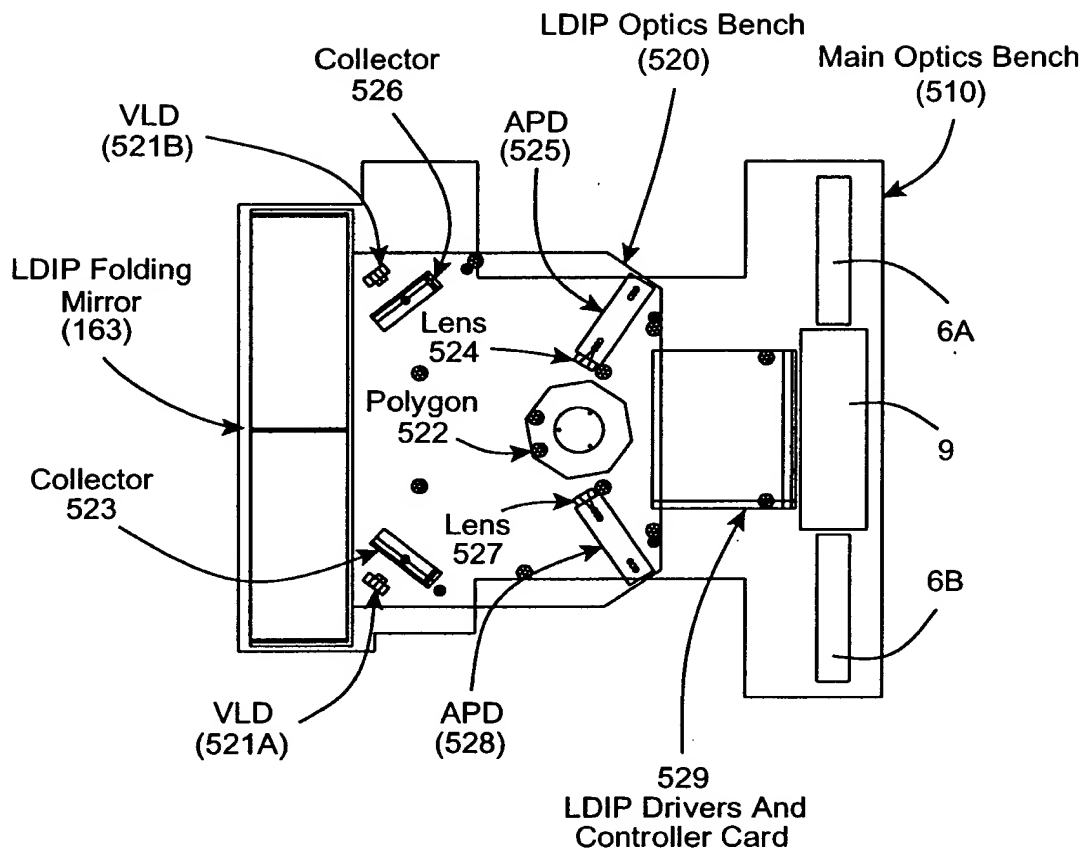
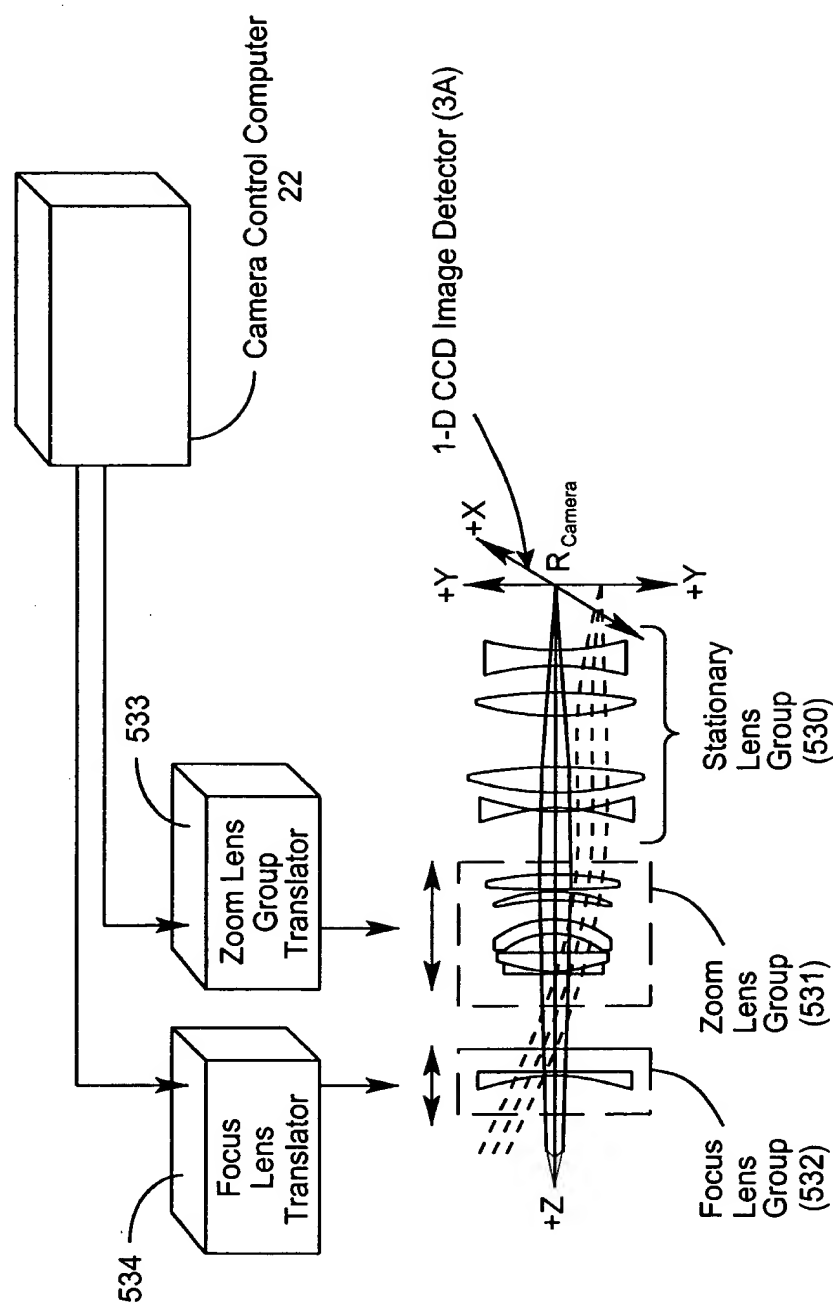


FIG. 12D



Main Optics Lens Groups

FIG. 12E

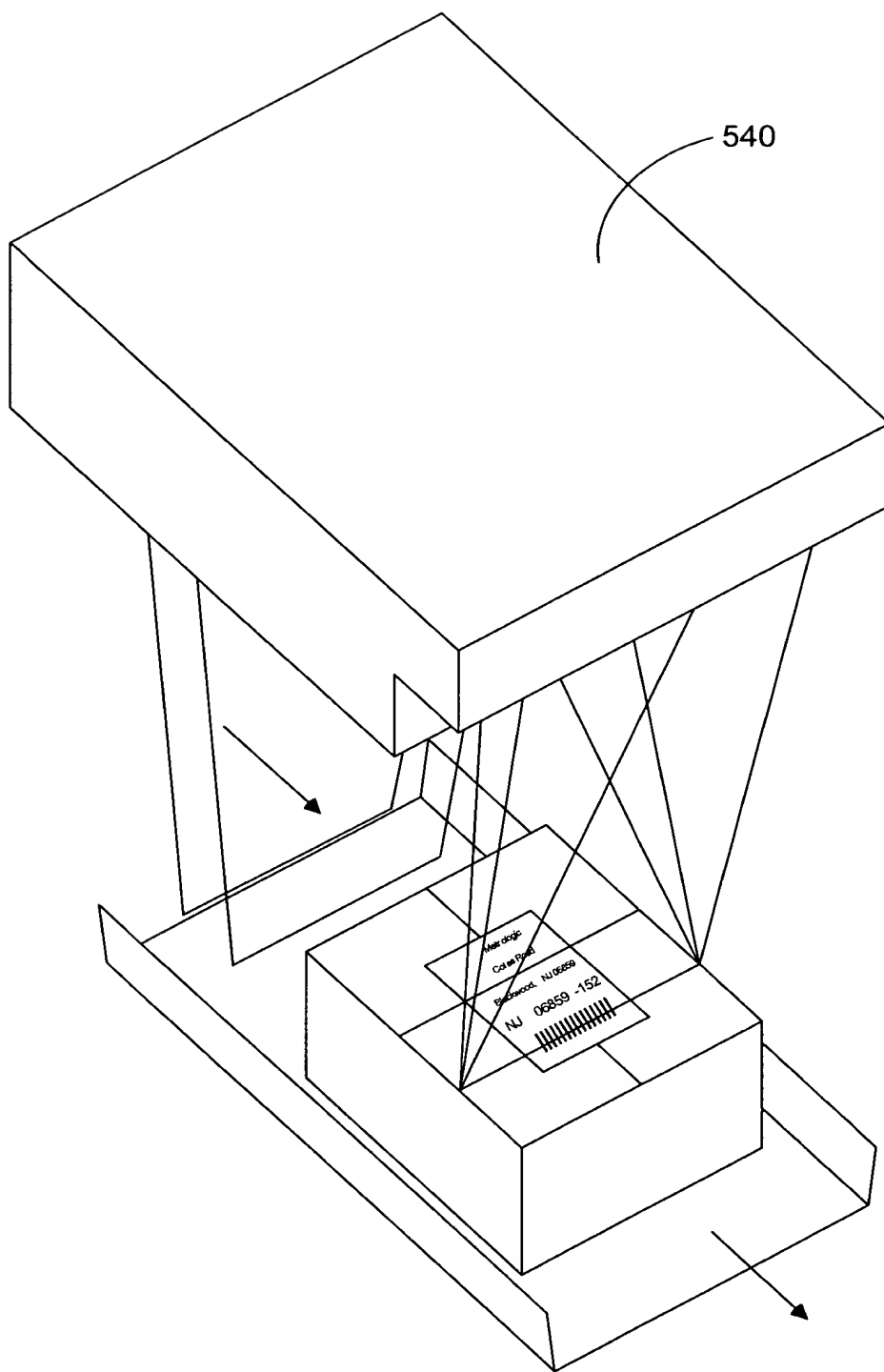


FIG. 13A

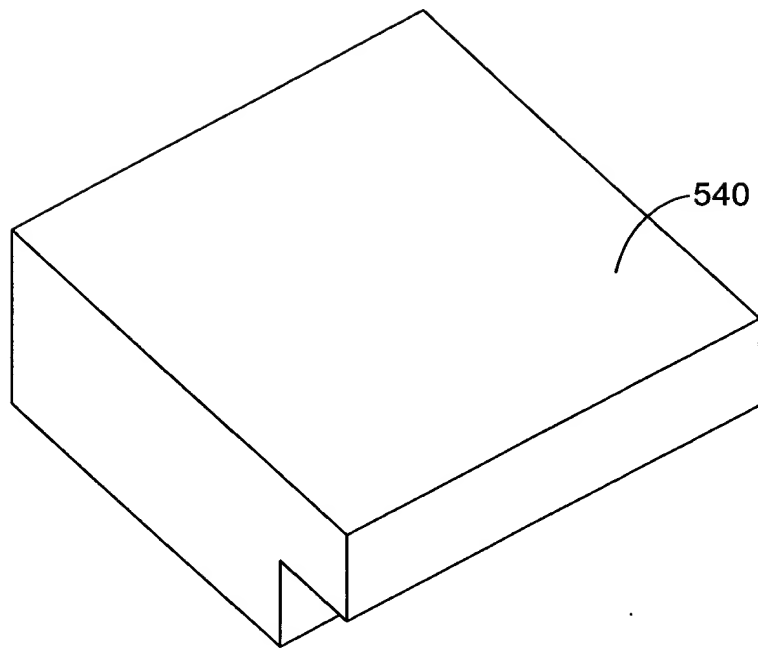


FIG. 13B

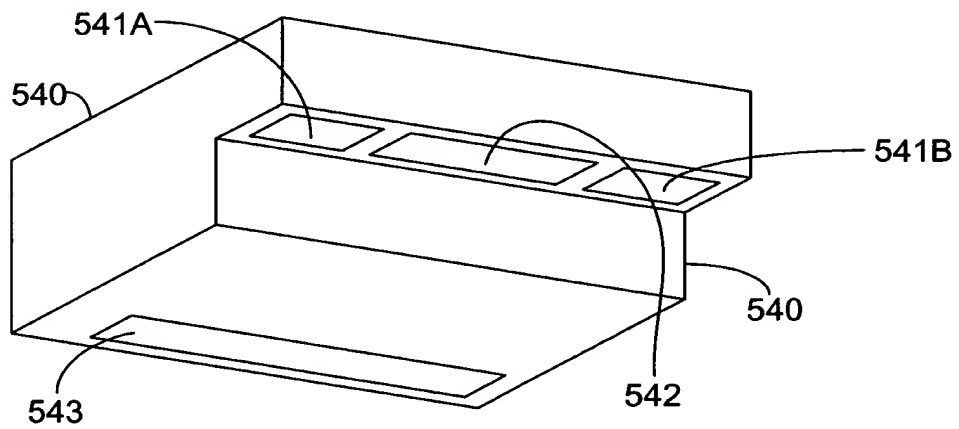


FIG. 13C



PLIIM-BASED PACKAGE IDENTIFICATION AND
DIMENSIONING (PID) SYSTEM

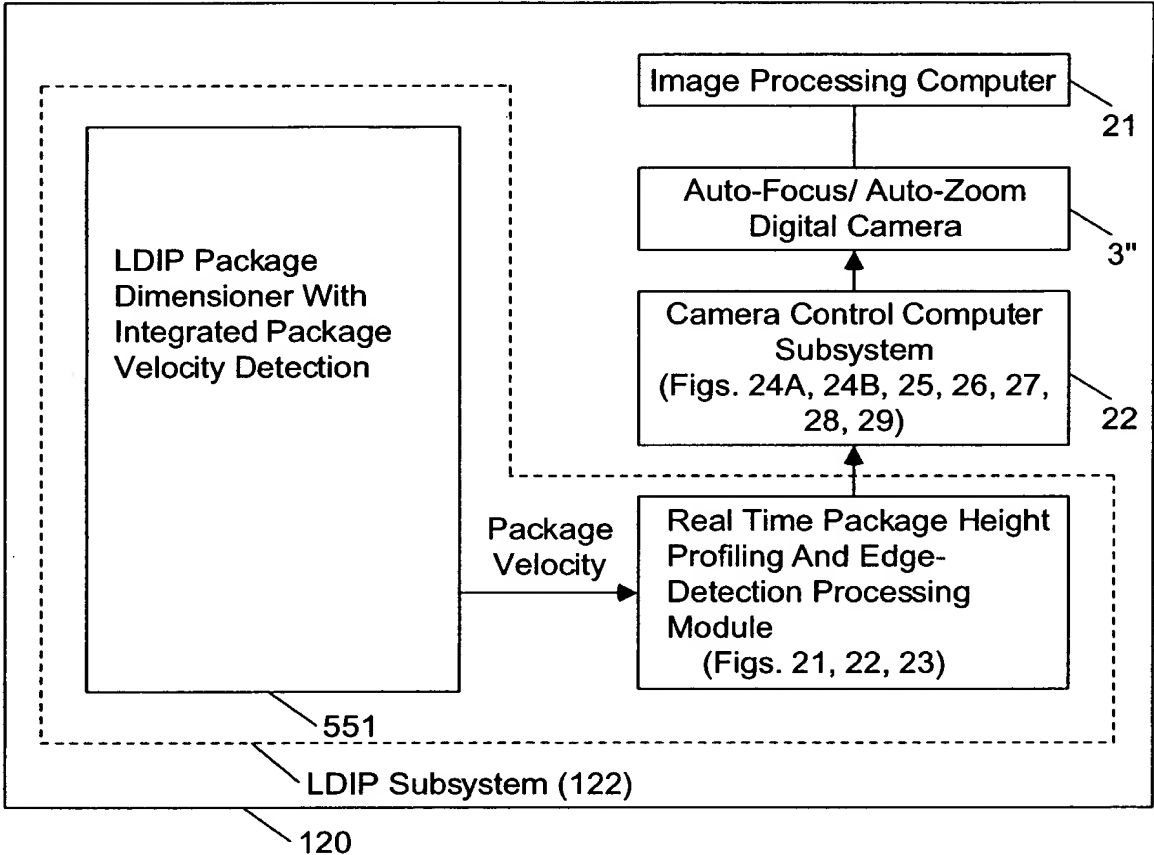


FIG. 14



LDIP REAL-TIME PACKAGE HEIGHT PROFILE AND EDGE DETECTION METHOD

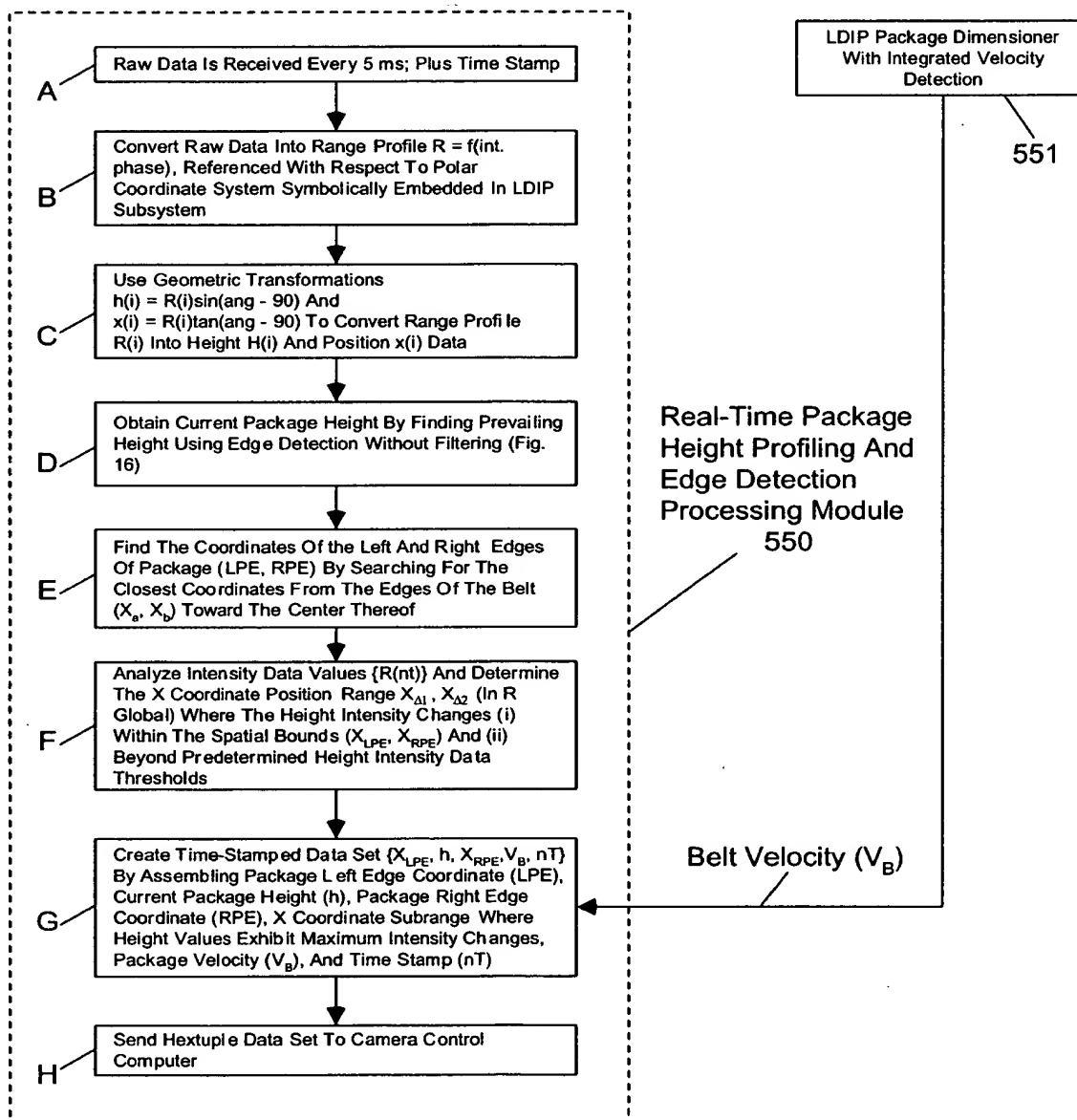
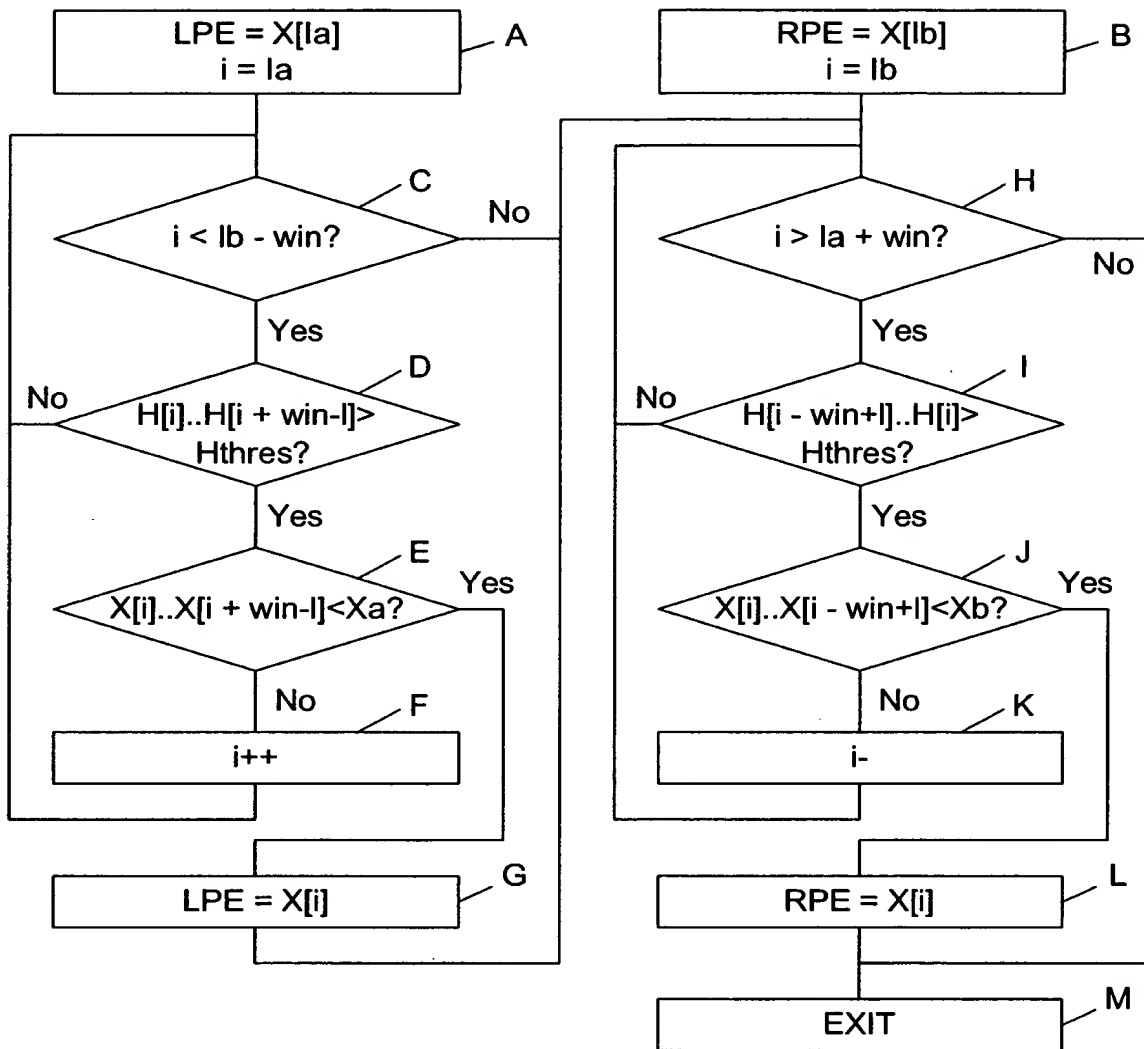


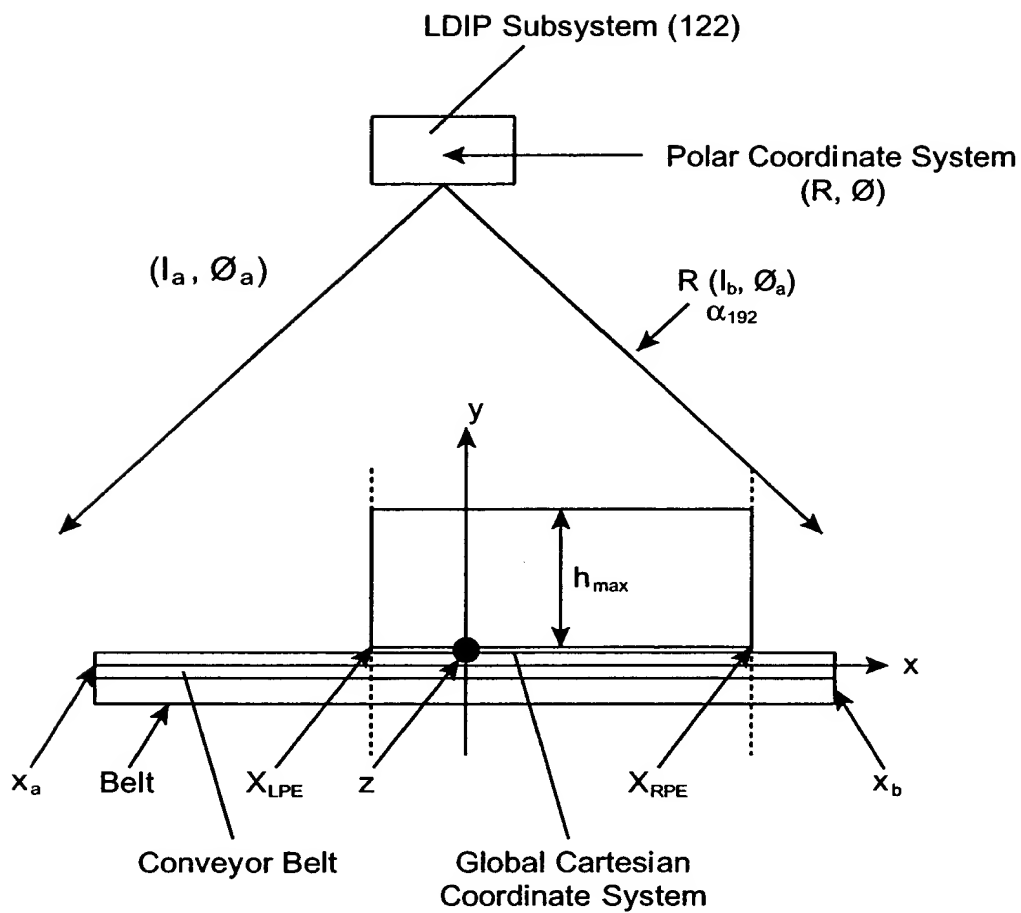
FIG. 15

LDIP REAL-TIME PACKAGE EDGE DETECTION



Xa = Location Of Belt Left Edge; Xb = Location Of Belt Right Edge
 la = Belt Left Edge Pixel; lb = Belt Right Edge Pixel
 LPE = Left package Edge; RPE = Right Package Edge
 H[] = Pixel Height Array; X[] = Pixel Location Array
 win = Package detection Window

FIG. 16





Information Measured At Scan Angles Before
Coordinate Transformations

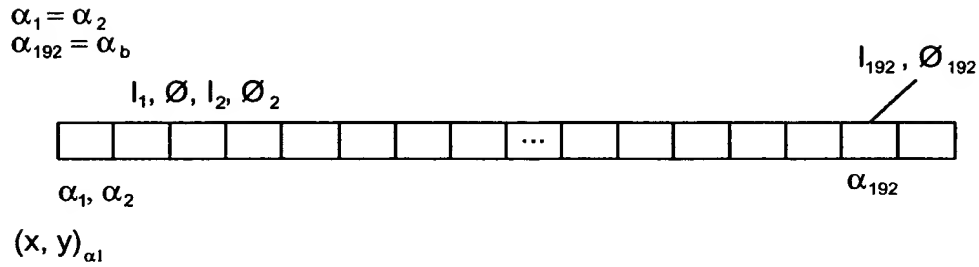


FIG. 17A

Range And Polar Angle Measures Taken At Scan
Angle α Before Coordinate Transforms

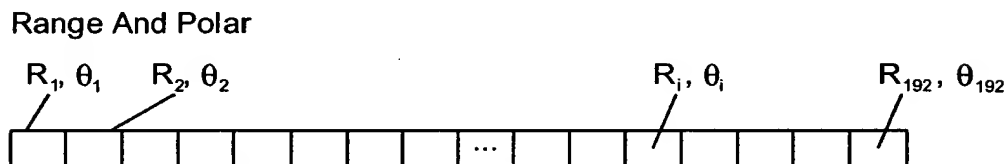


FIG. 17B

Measured Package Height And Position Values
After Coordinate Transforms

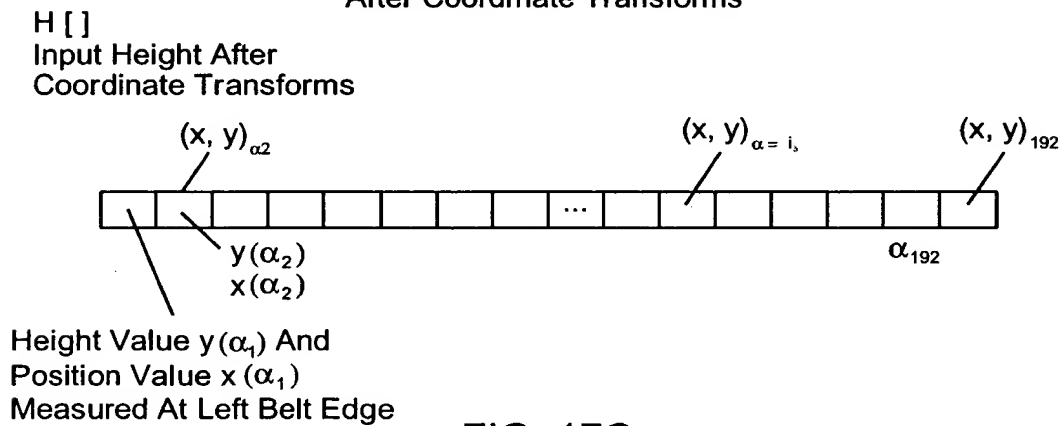


FIG. 17C

CAMERA CONTROL PROCESS CARRIED OUT WITHIN THE
CAMERA CONTROL SUBSYSTEM OF EACH OBJECT ATTRIBUTE
ACQUISITION AND ANALYSIS SYSTEM

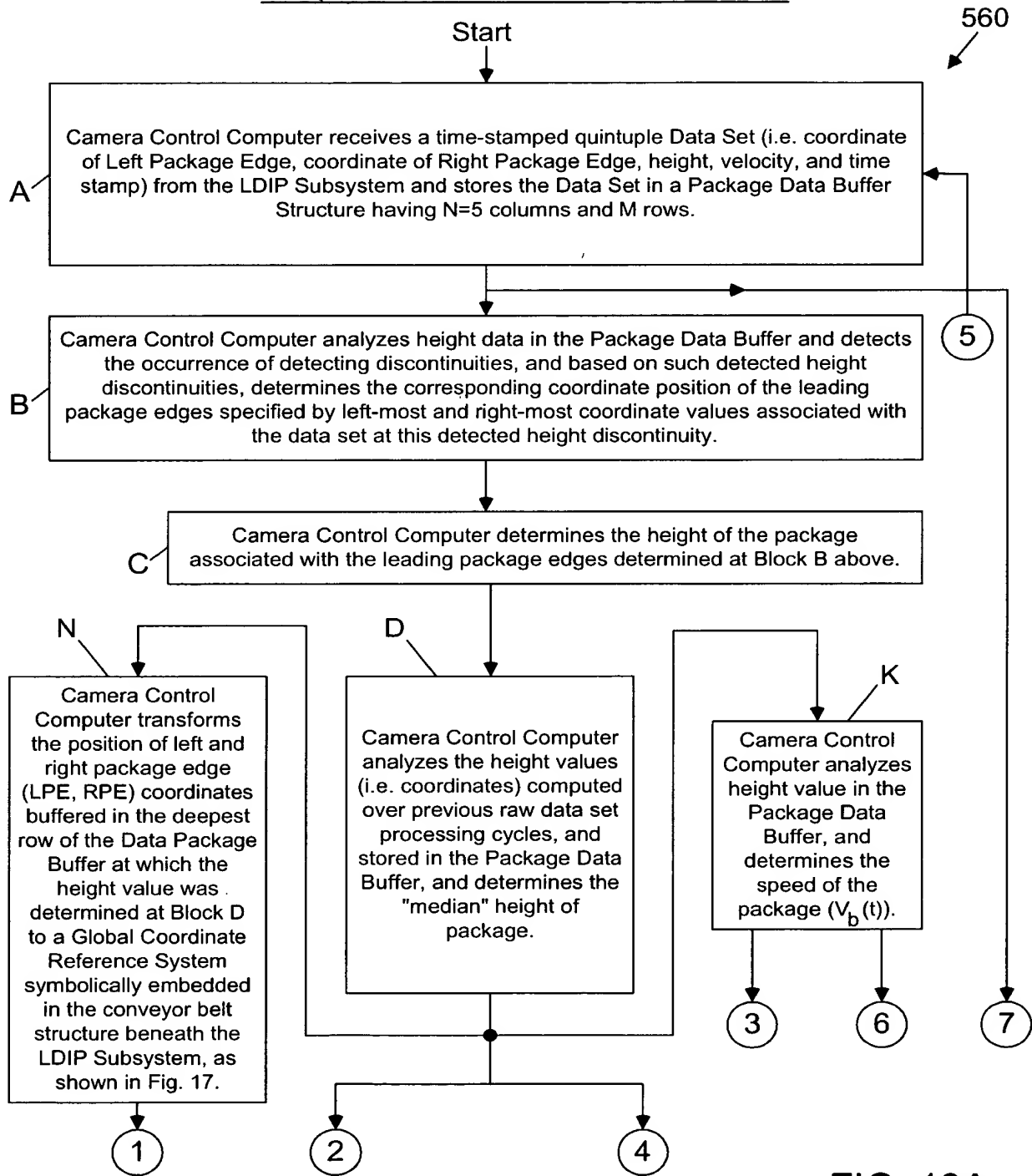


FIG. 18A

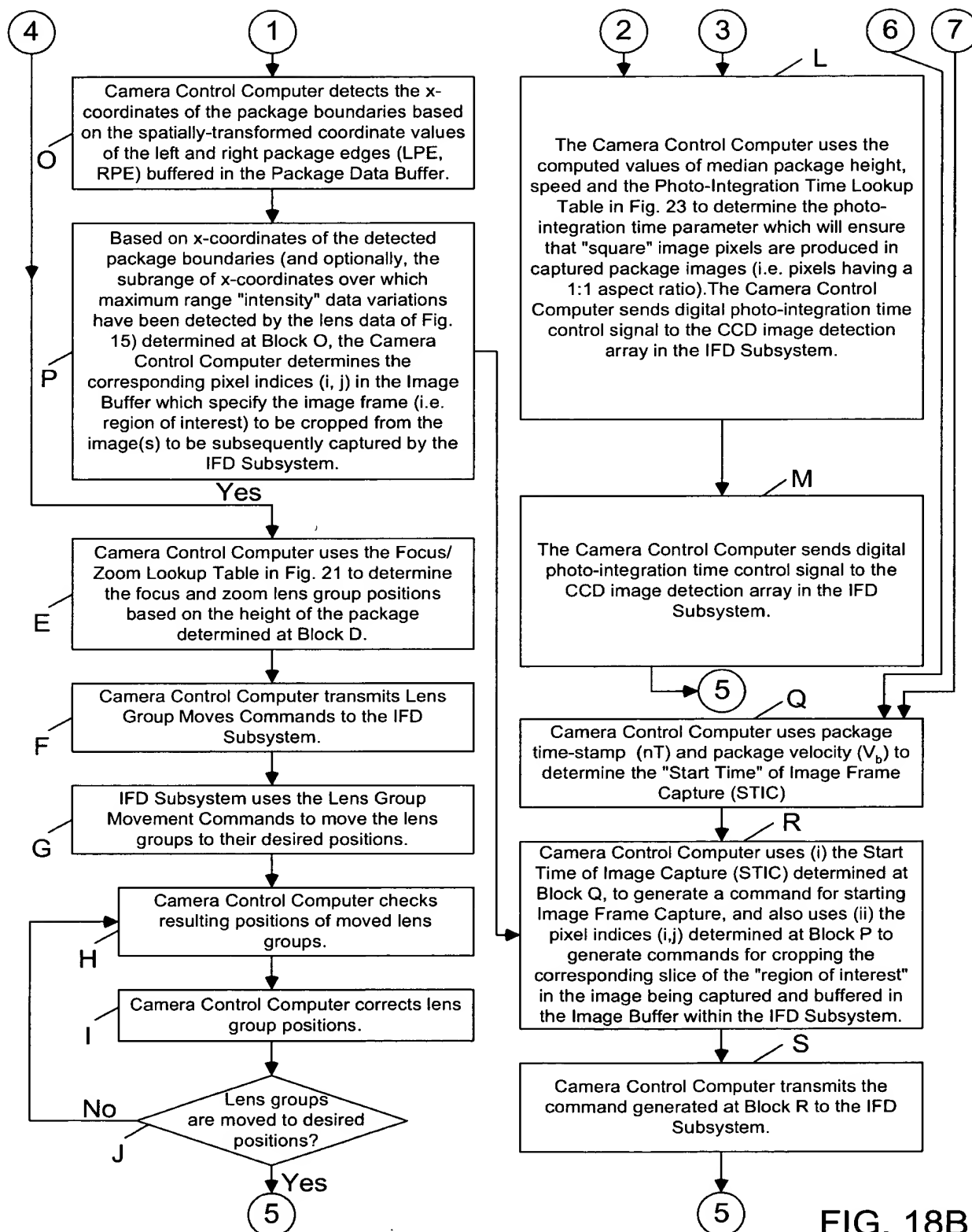
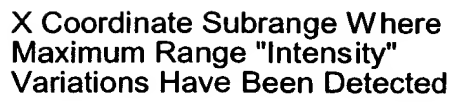


FIG. 18B

FIG. 19



Zoom And Focus Lens Group Position
Look-Up Table

Distance From Camera H (mm)	Zoom Group Distance (mm) Y (Zoom)	Focus Group Distance (mm) Y (Focus)
1000	21.57489228	2.47E-05
1100	19.38089696	10.99009783
1200	17.10673434	20.65783177
1300	14.77137314	29.10917002
1400	12.39153565	36.47312595
1500	9.979114358	42.87845436
1600	7.540639114	48.44003358
1700	5.078794775	53.25495831
1800	2.595989366	57.40834303
1900	0.099972739	60.98883615
(Use Interpolation Techniques For Working Distances Between Listed Points In Table)		

FIG. 21



* Note: The focal distance and zoom (eff. focal length) of camera lens are coupled (inter-dependant) in this commercial embodiment.

Camera Has A Fixed Aperture F56

Focus And Zoom Lens Movement vs. Working Distances

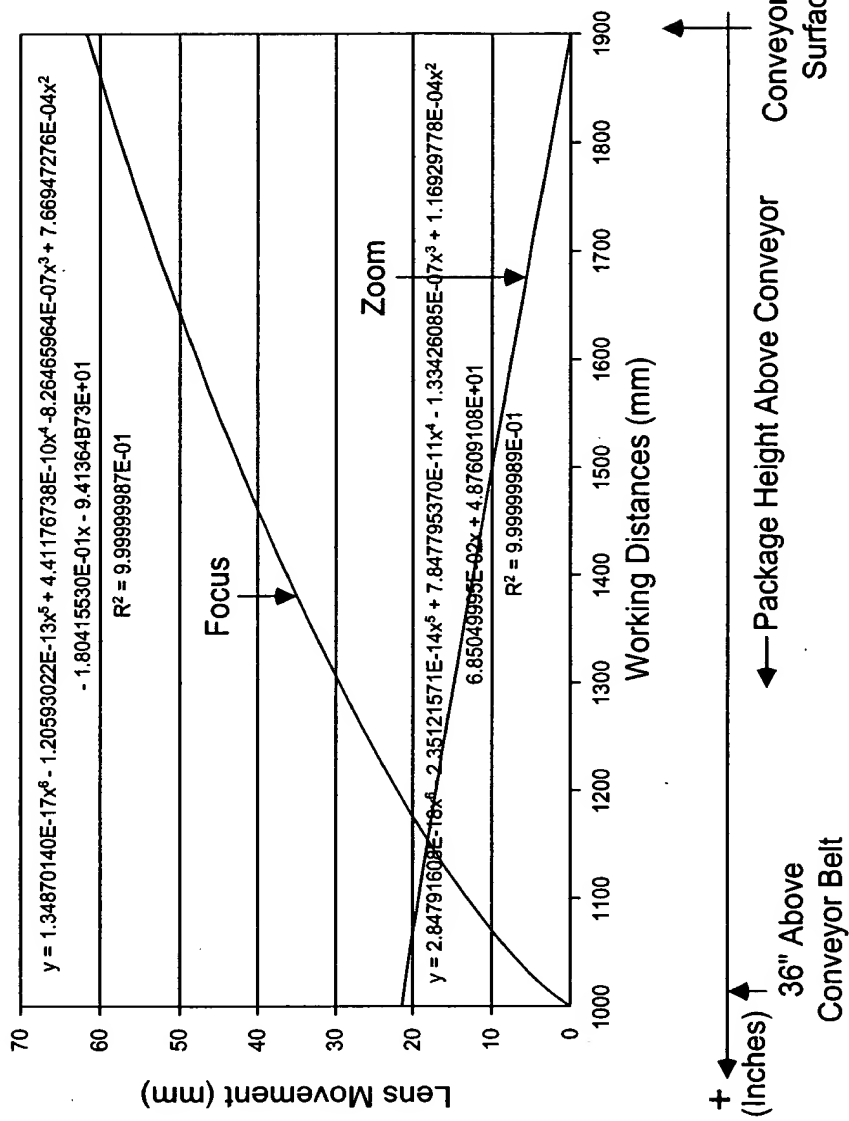


FIG. 22



Photo-Integration Time Look-Up Table

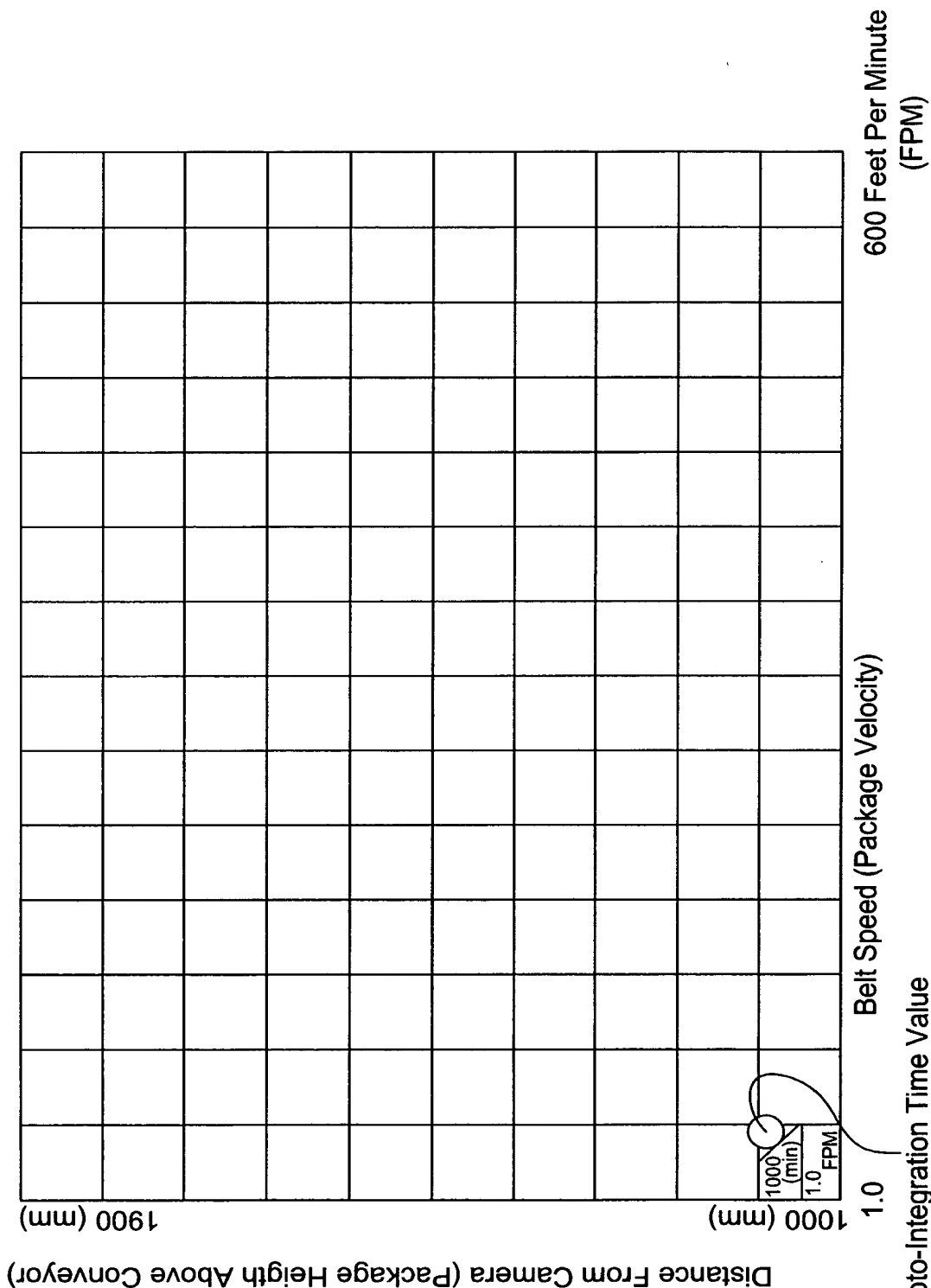


FIG. 23

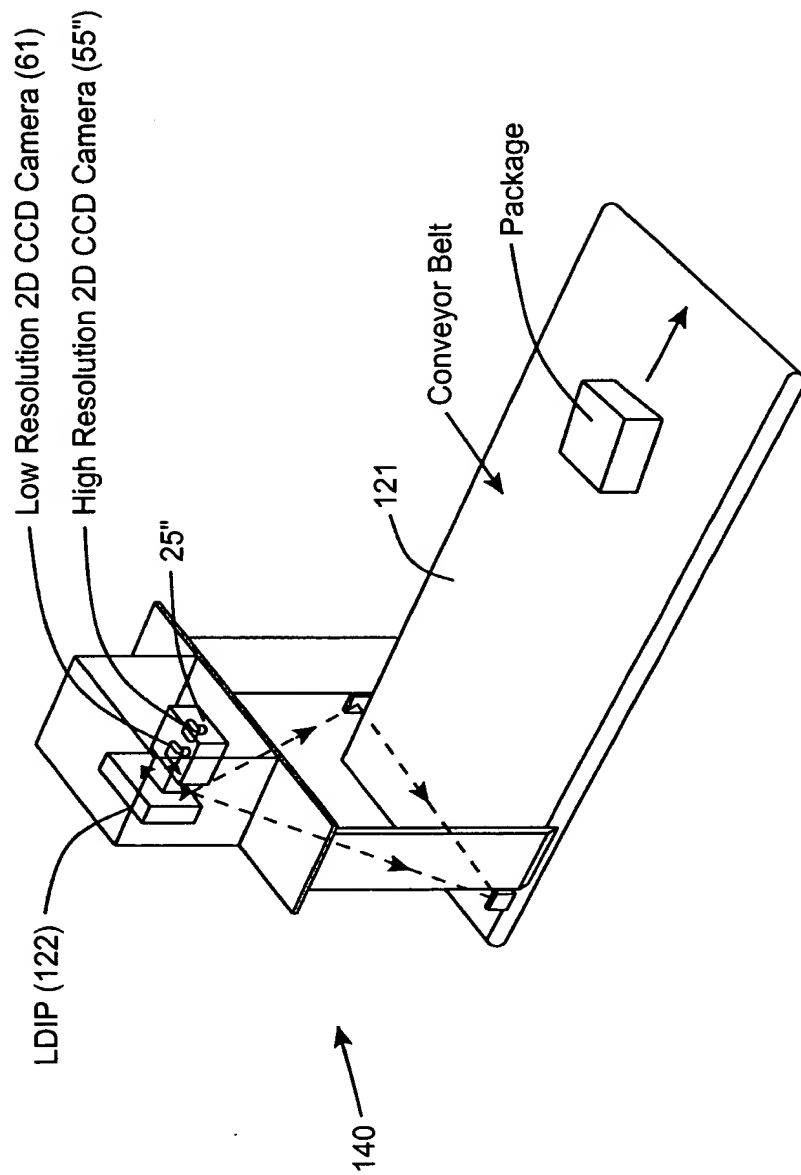


FIG. 24

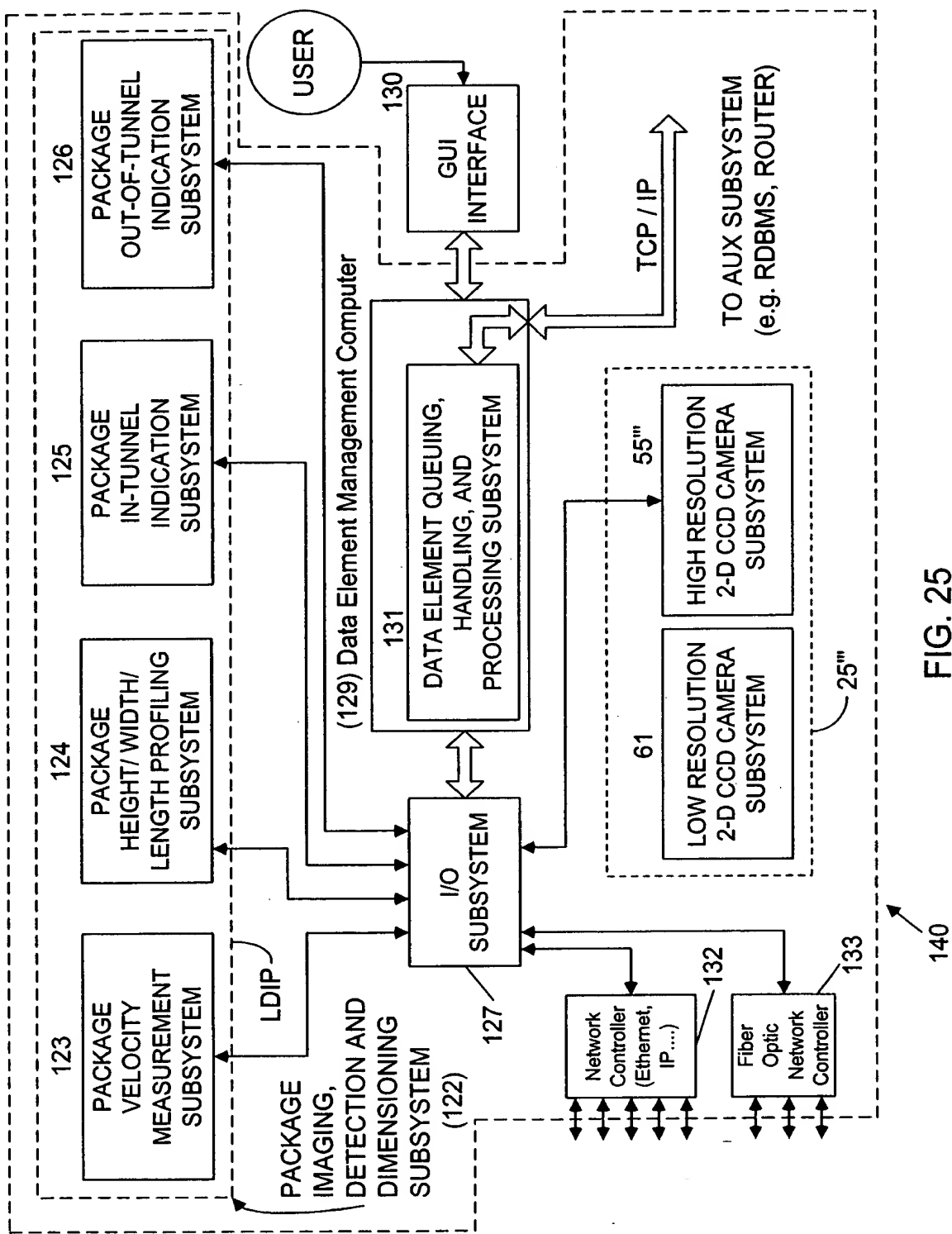


FIG. 25

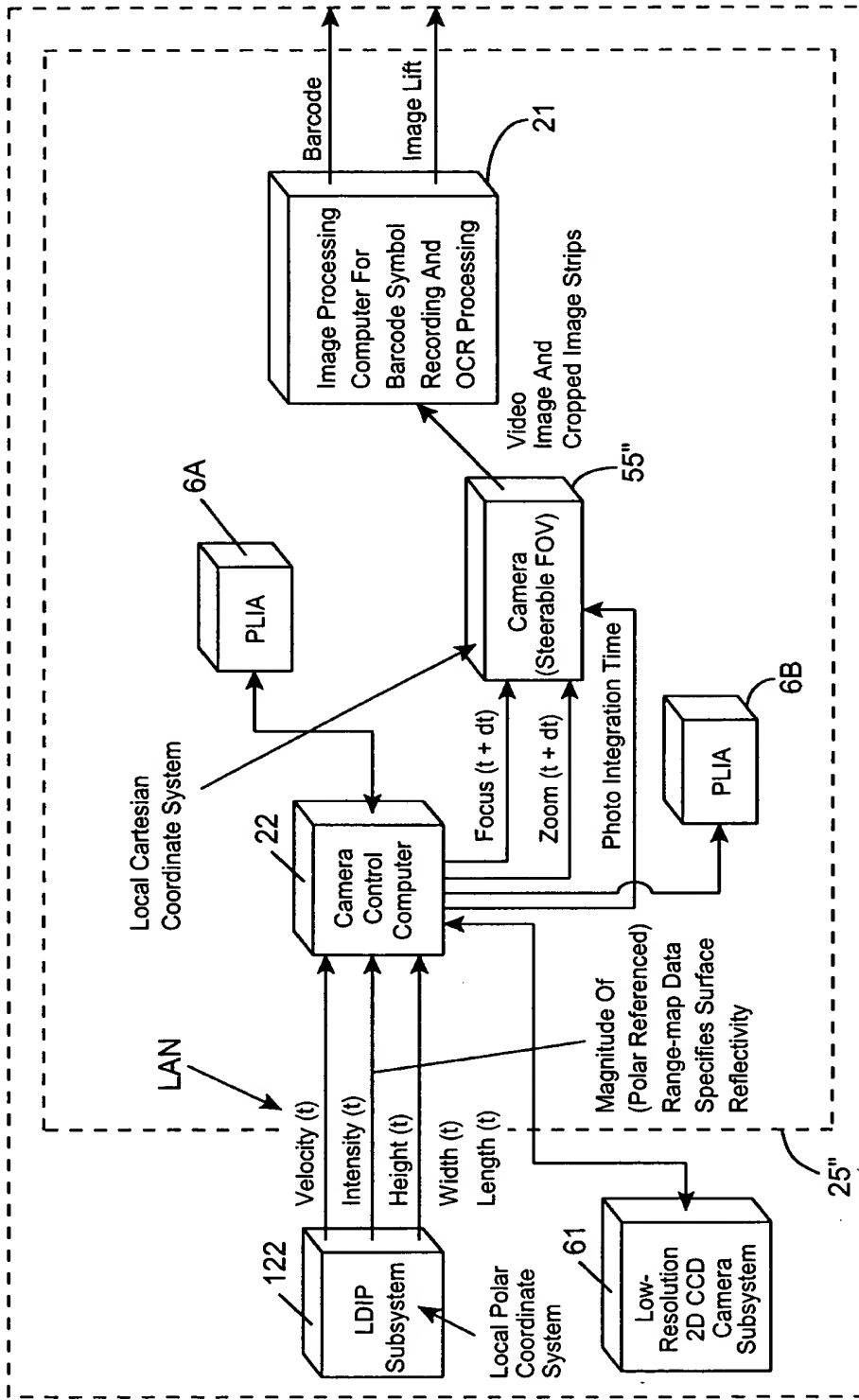
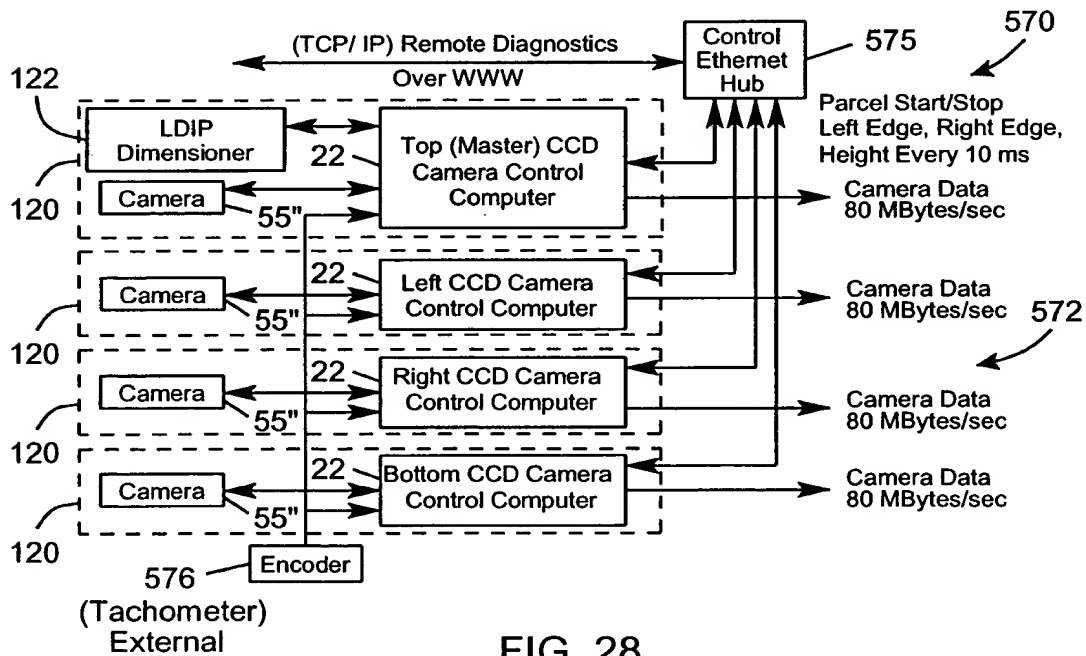
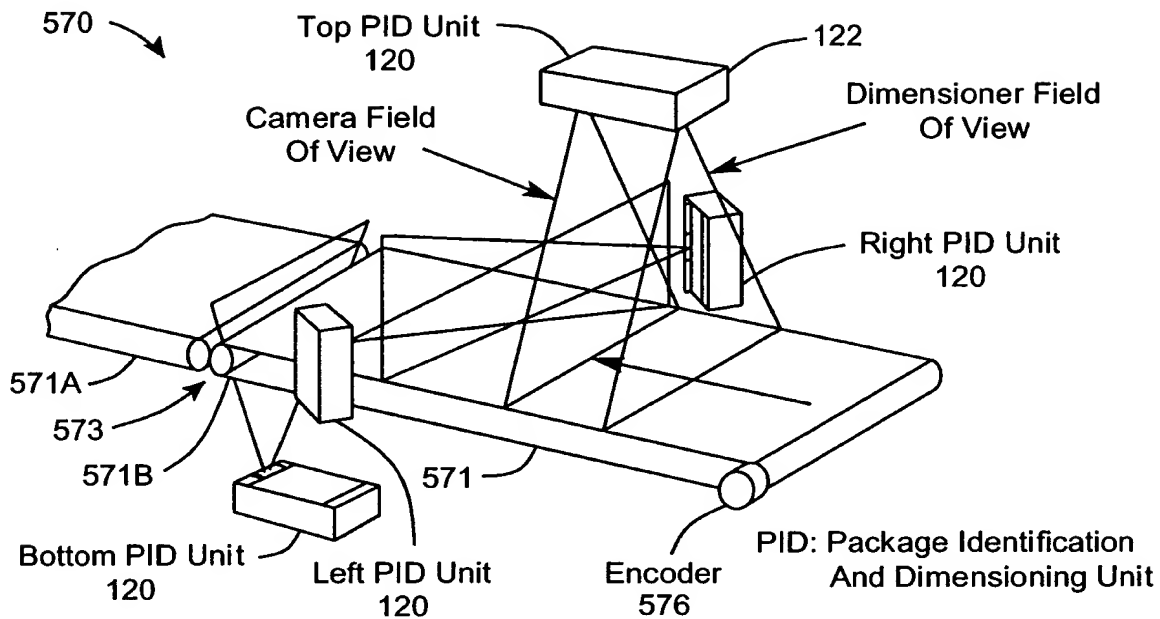


FIG. 26



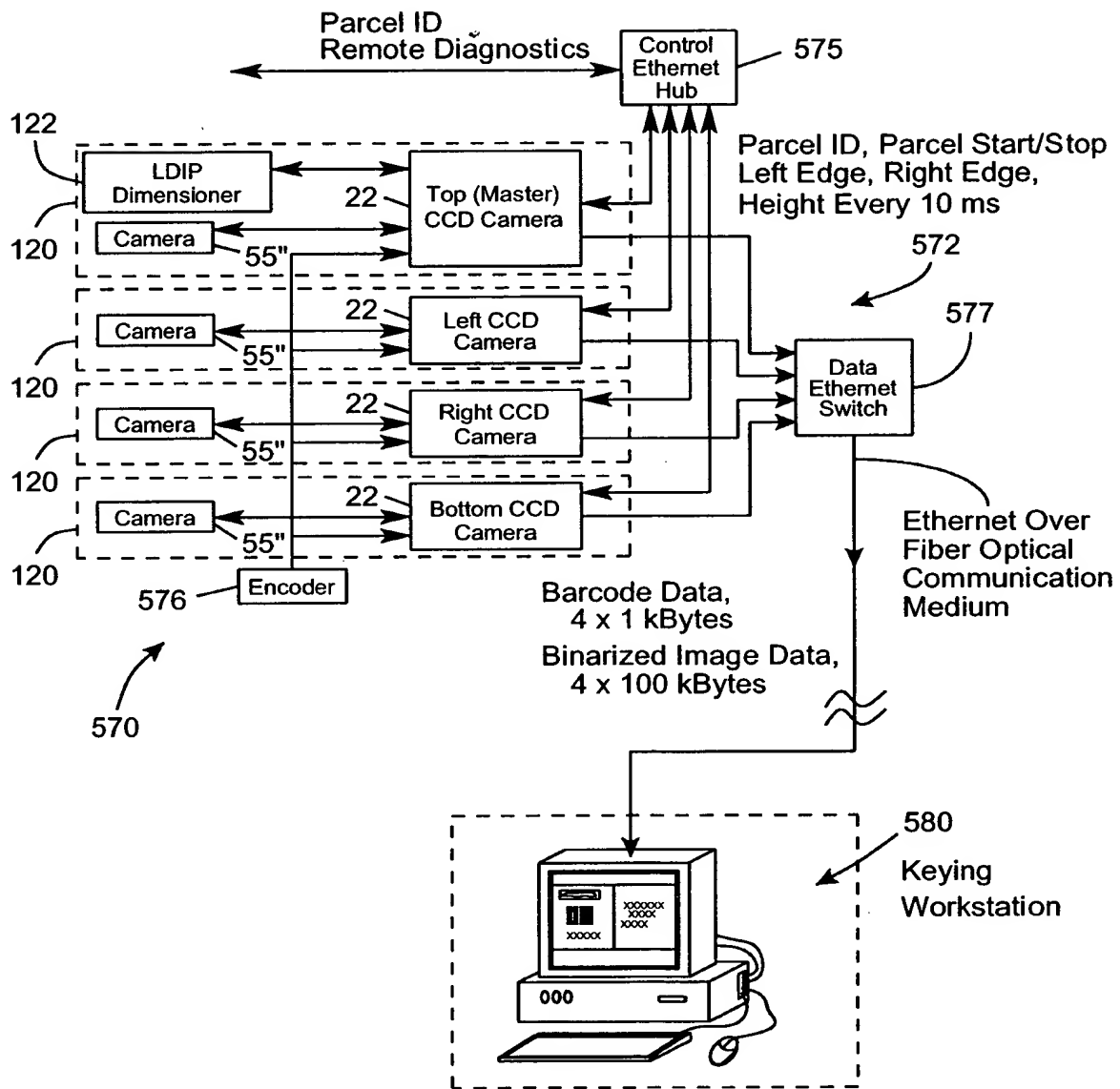


FIG. 29

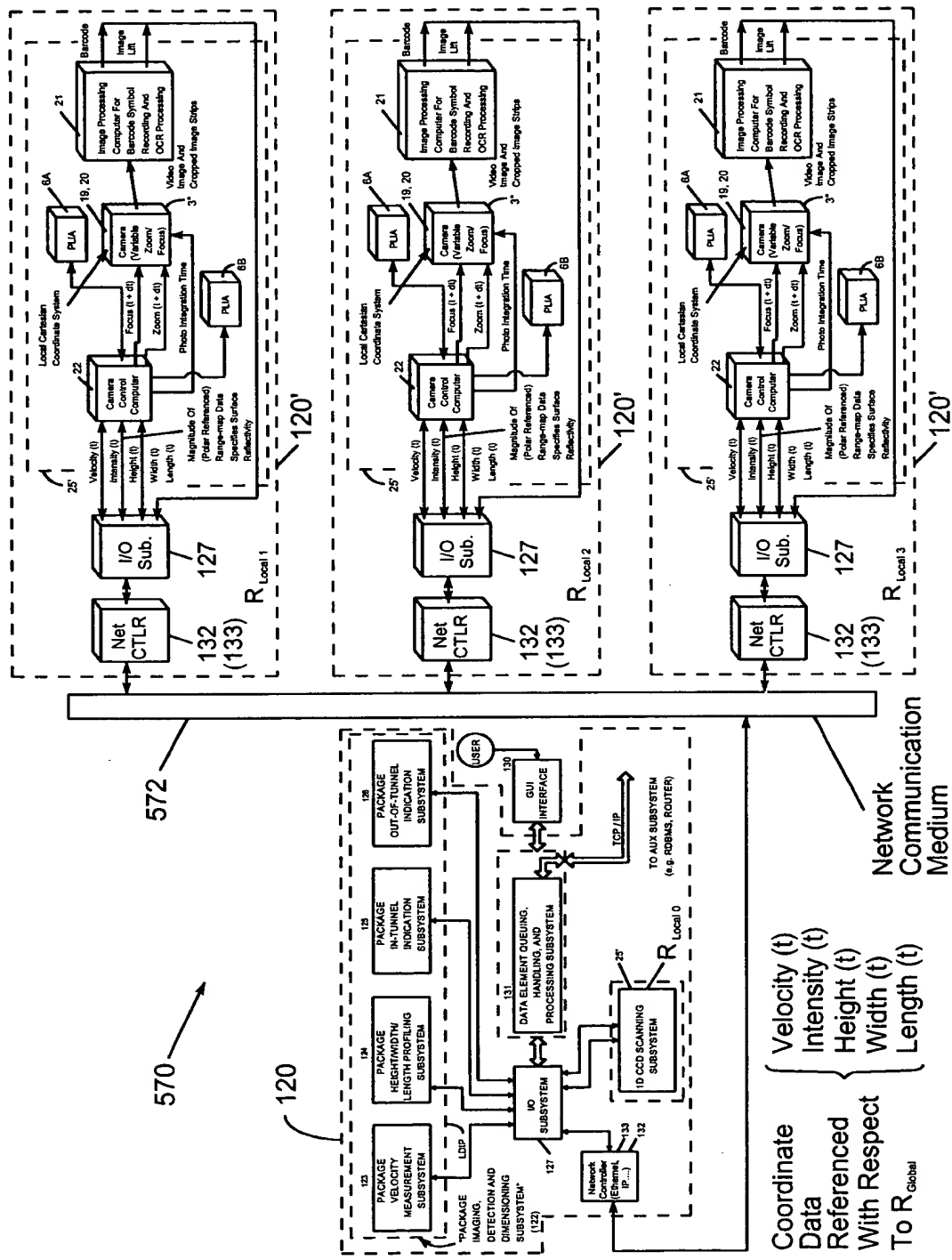


FIG. 30

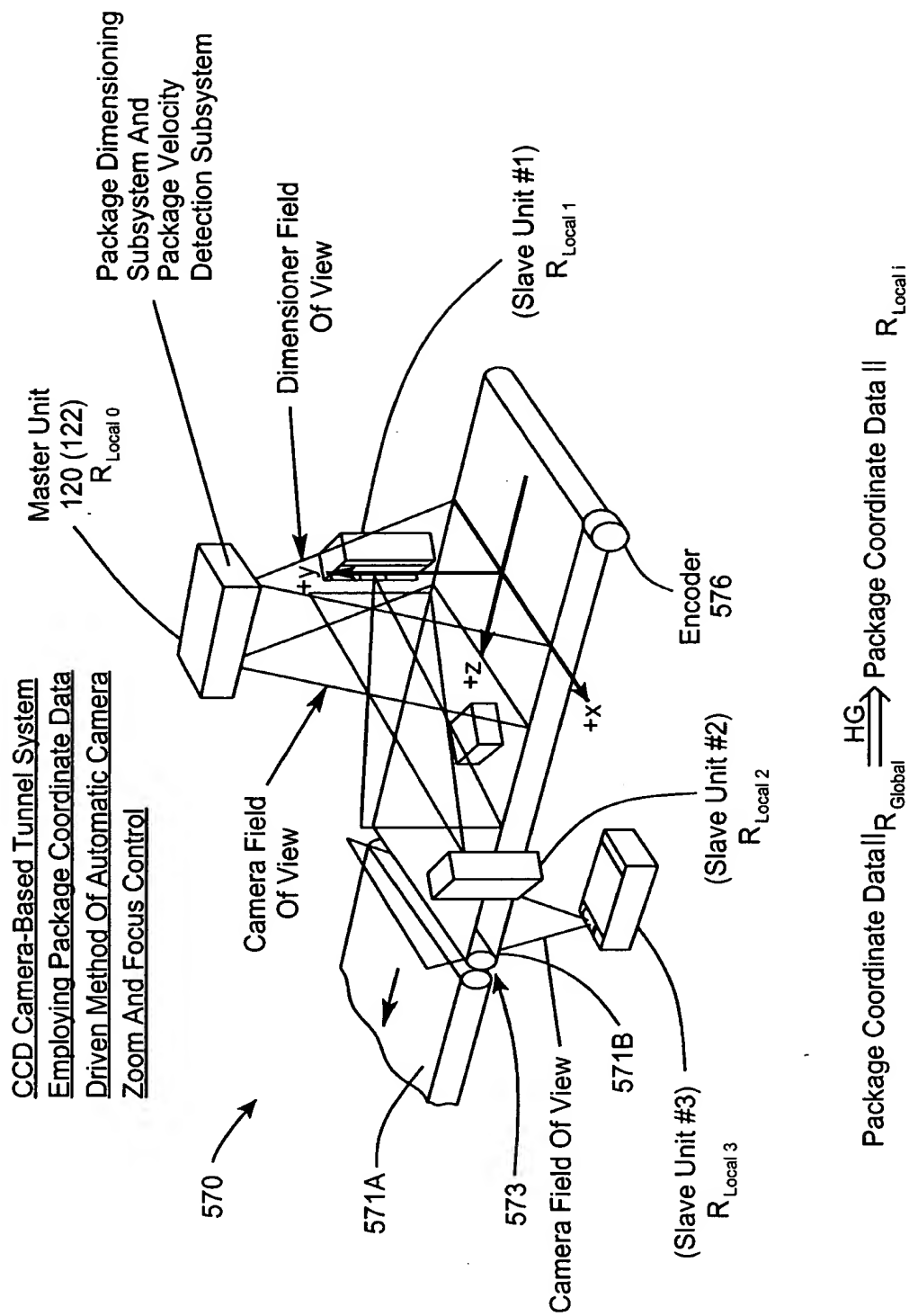


FIG. 31

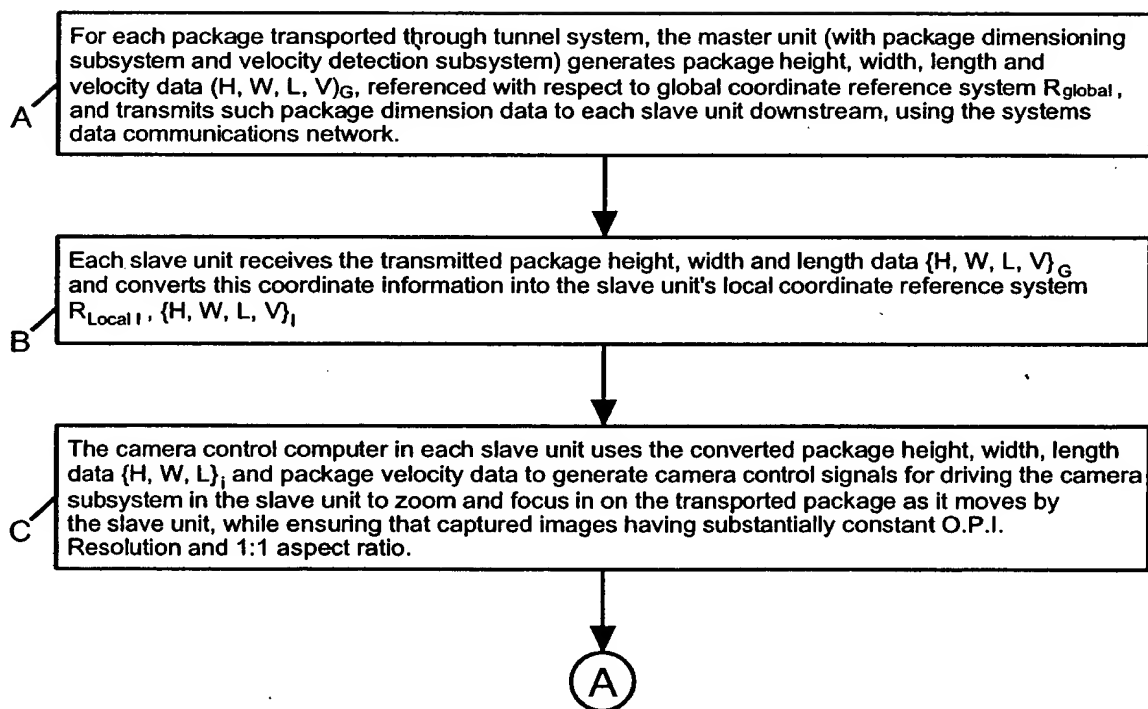


FIG. 32A

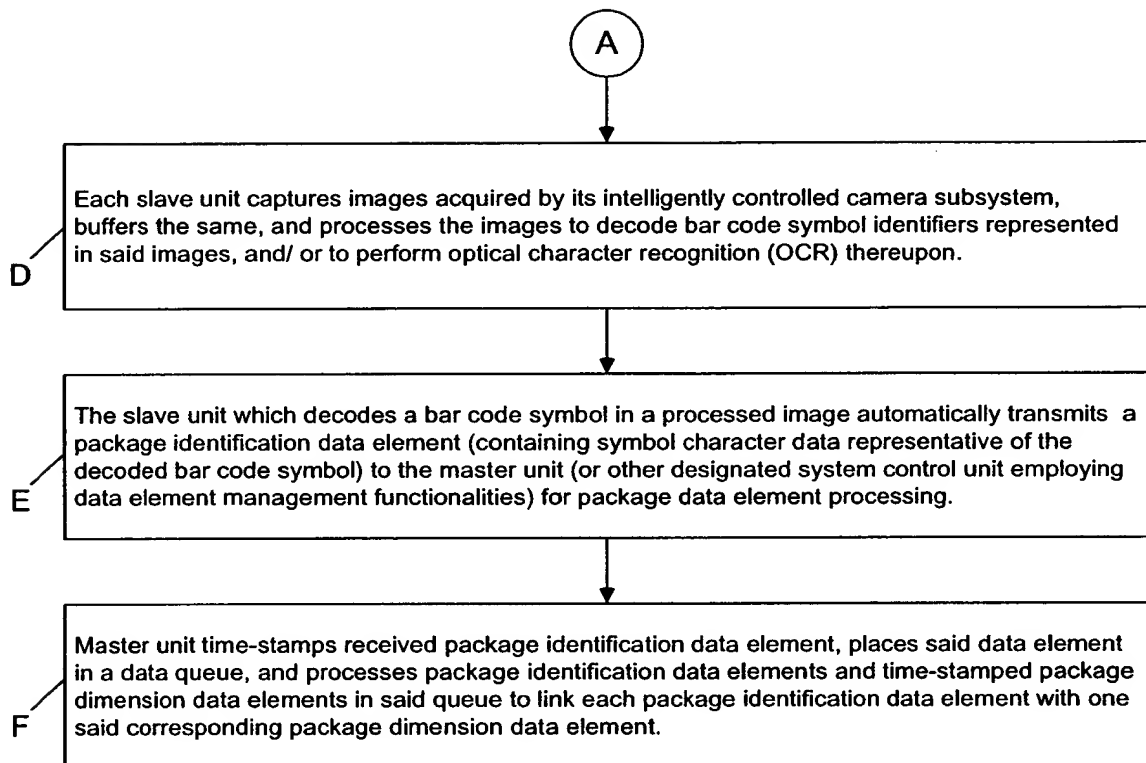


FIG. 32B

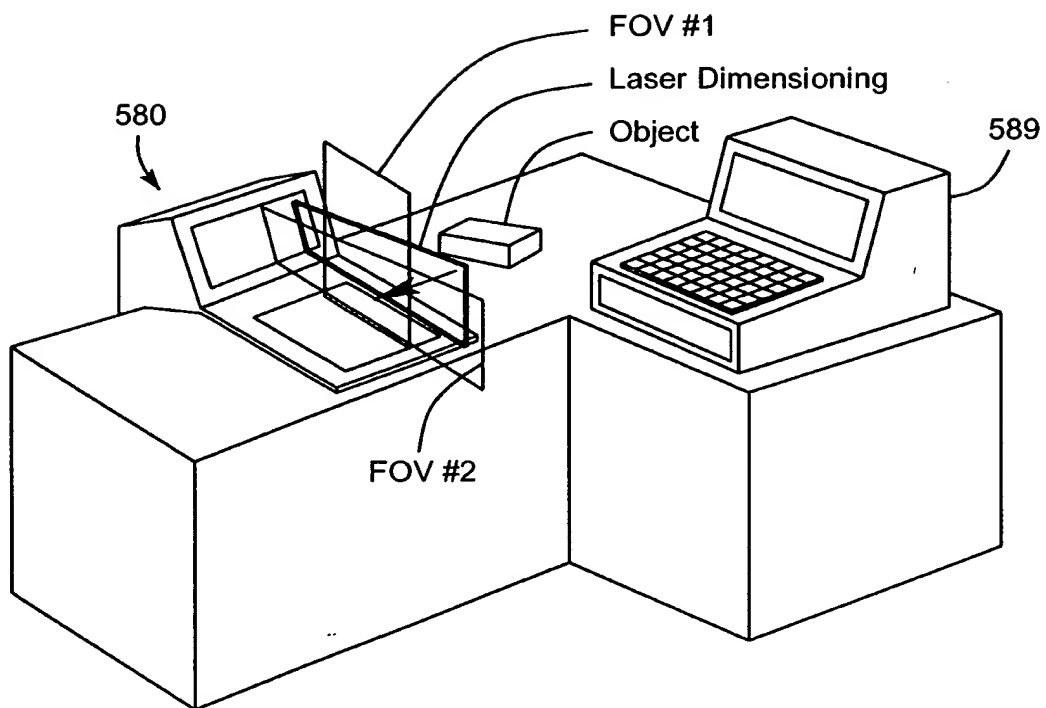


FIG. 33A

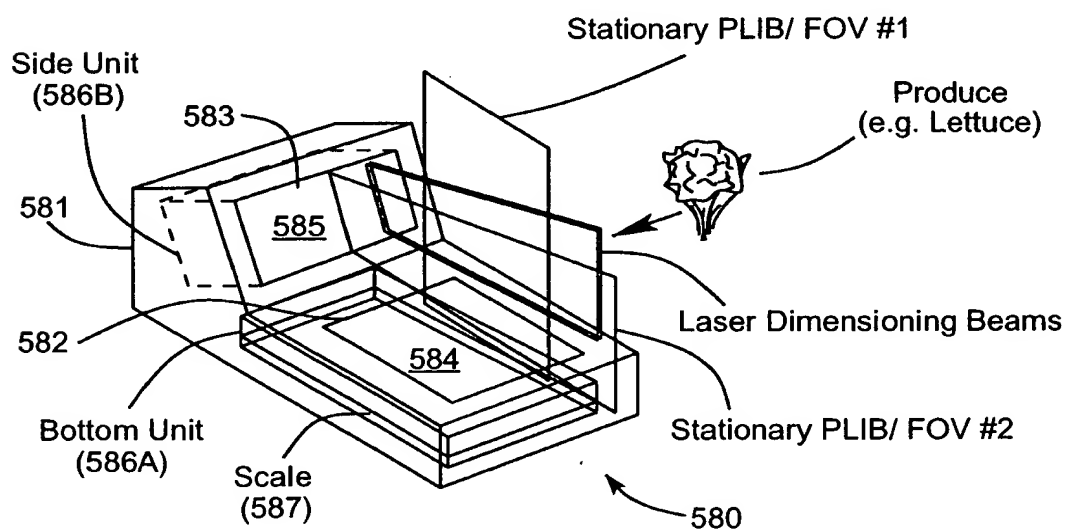


FIG. 33B

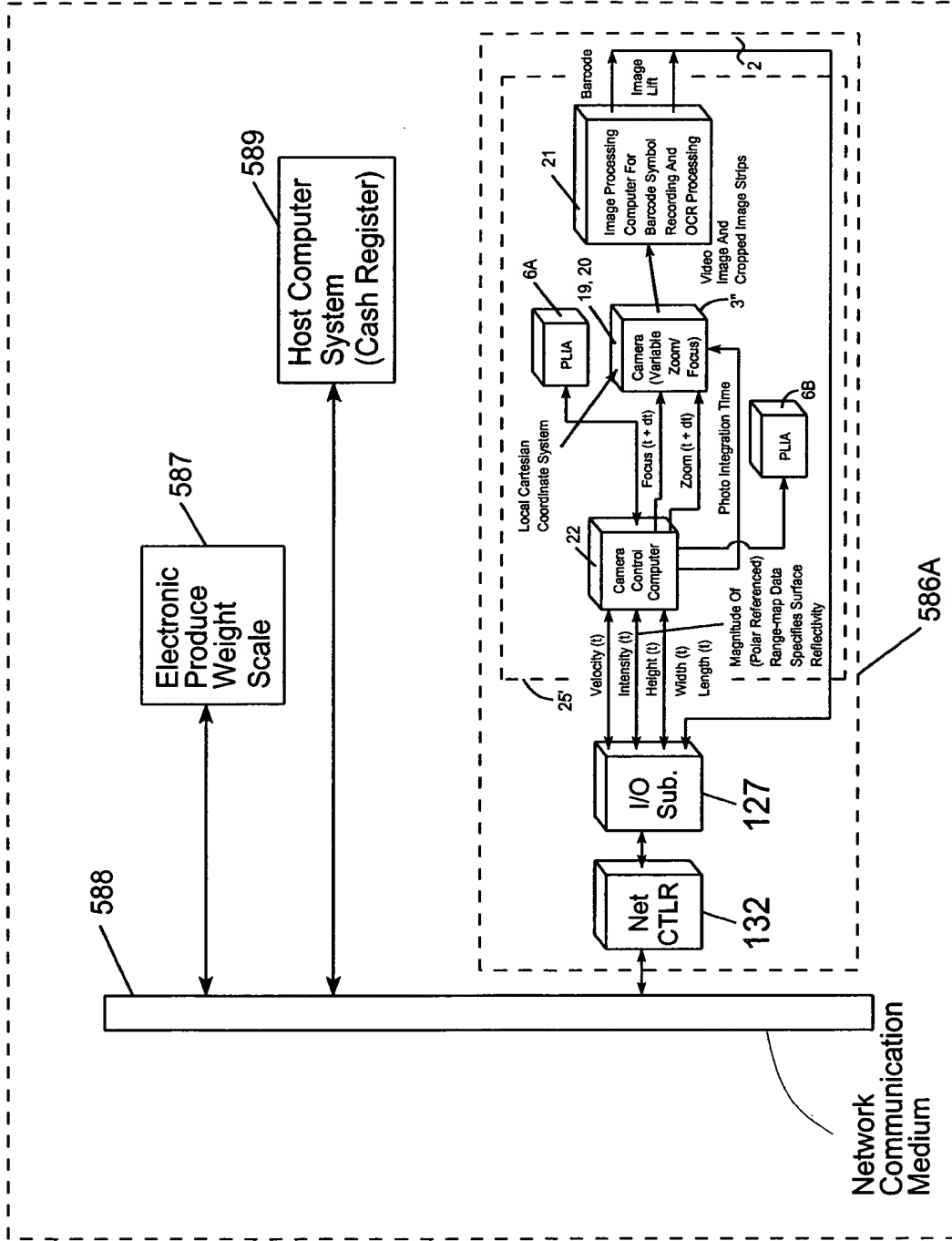


FIG. 33C1

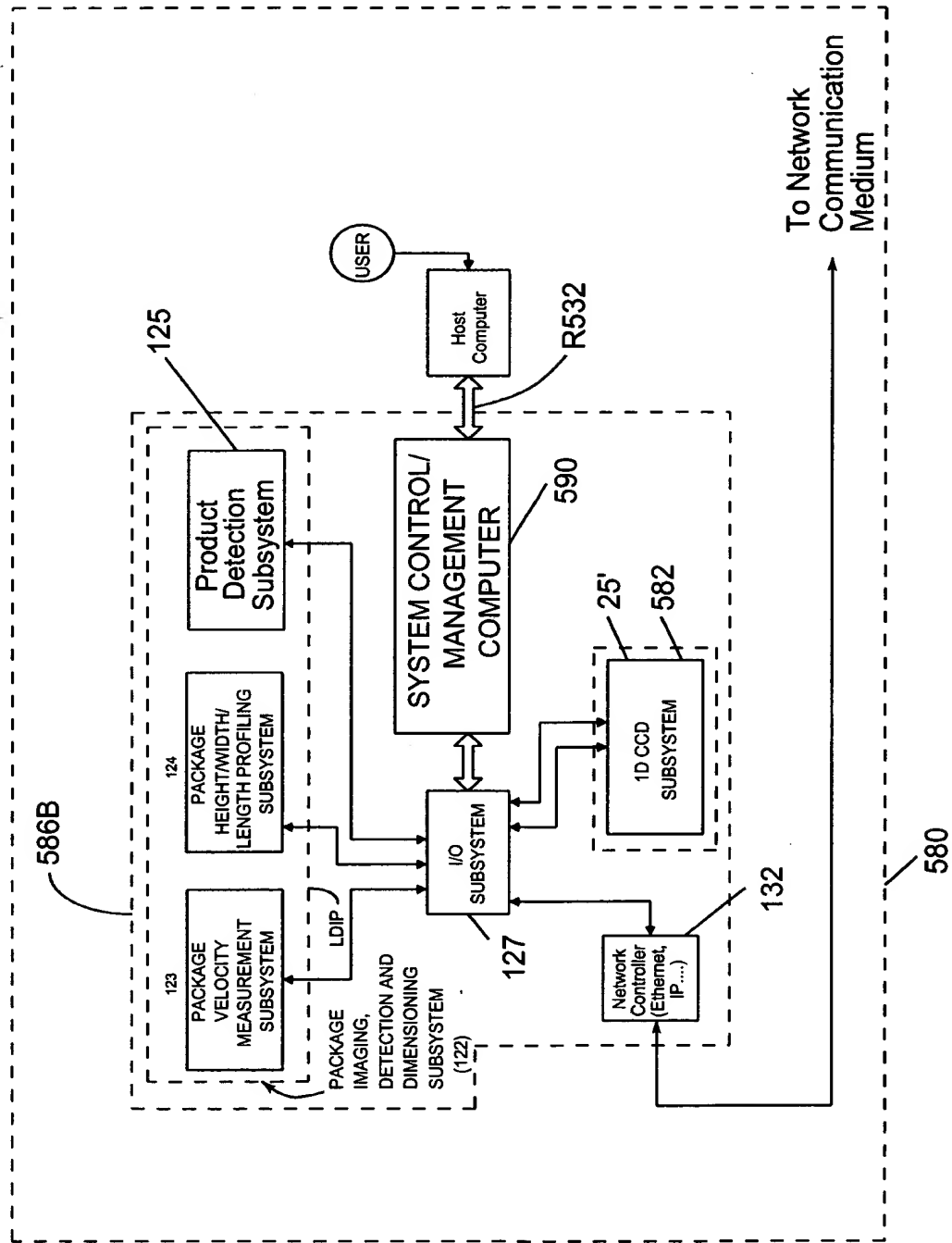


FIG. 33C2

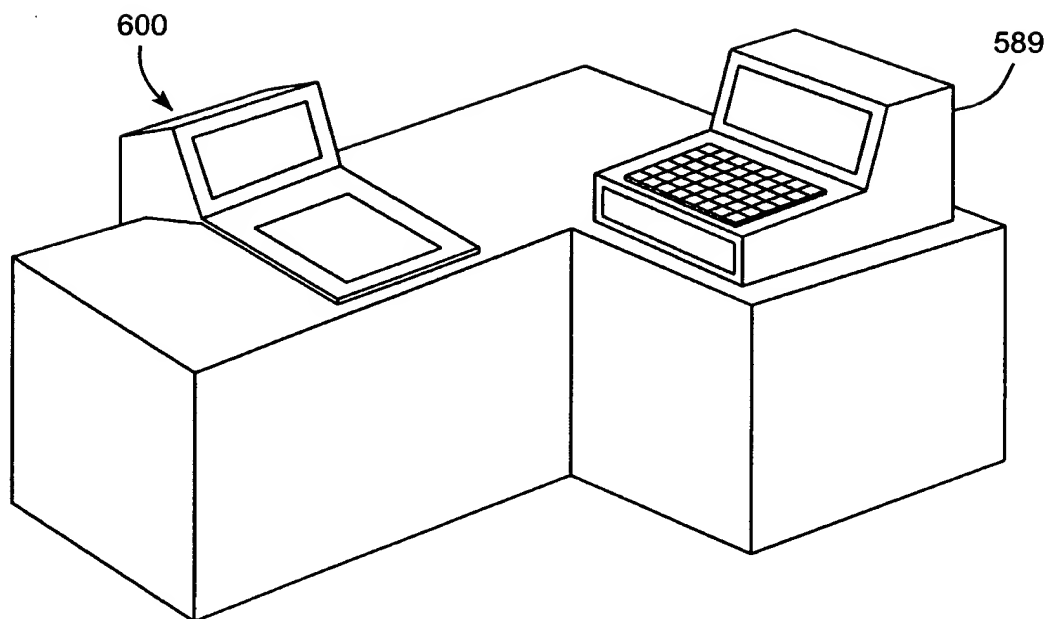


FIG. 34A

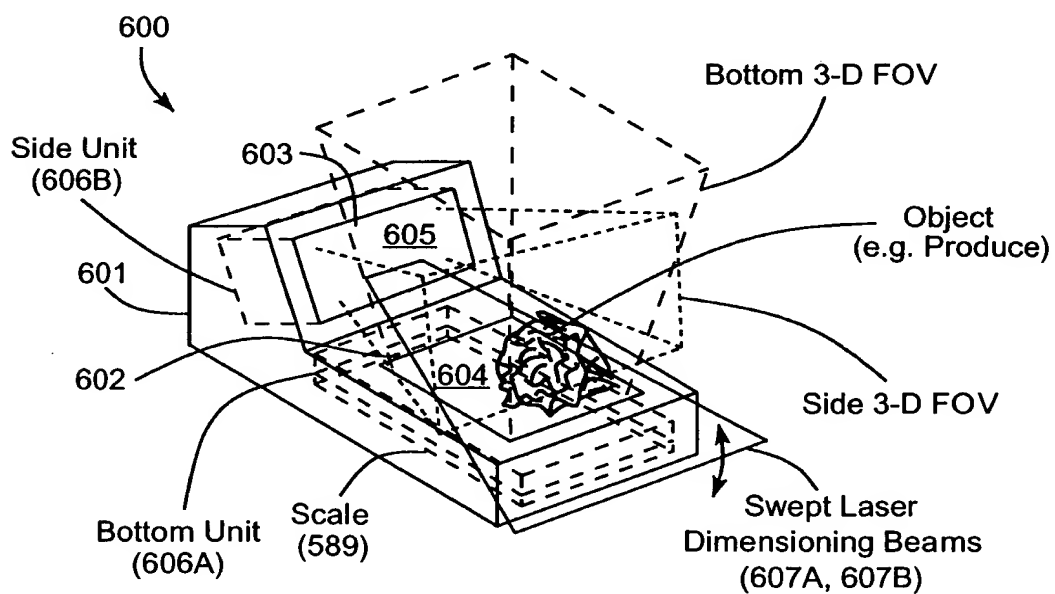


FIG. 34B

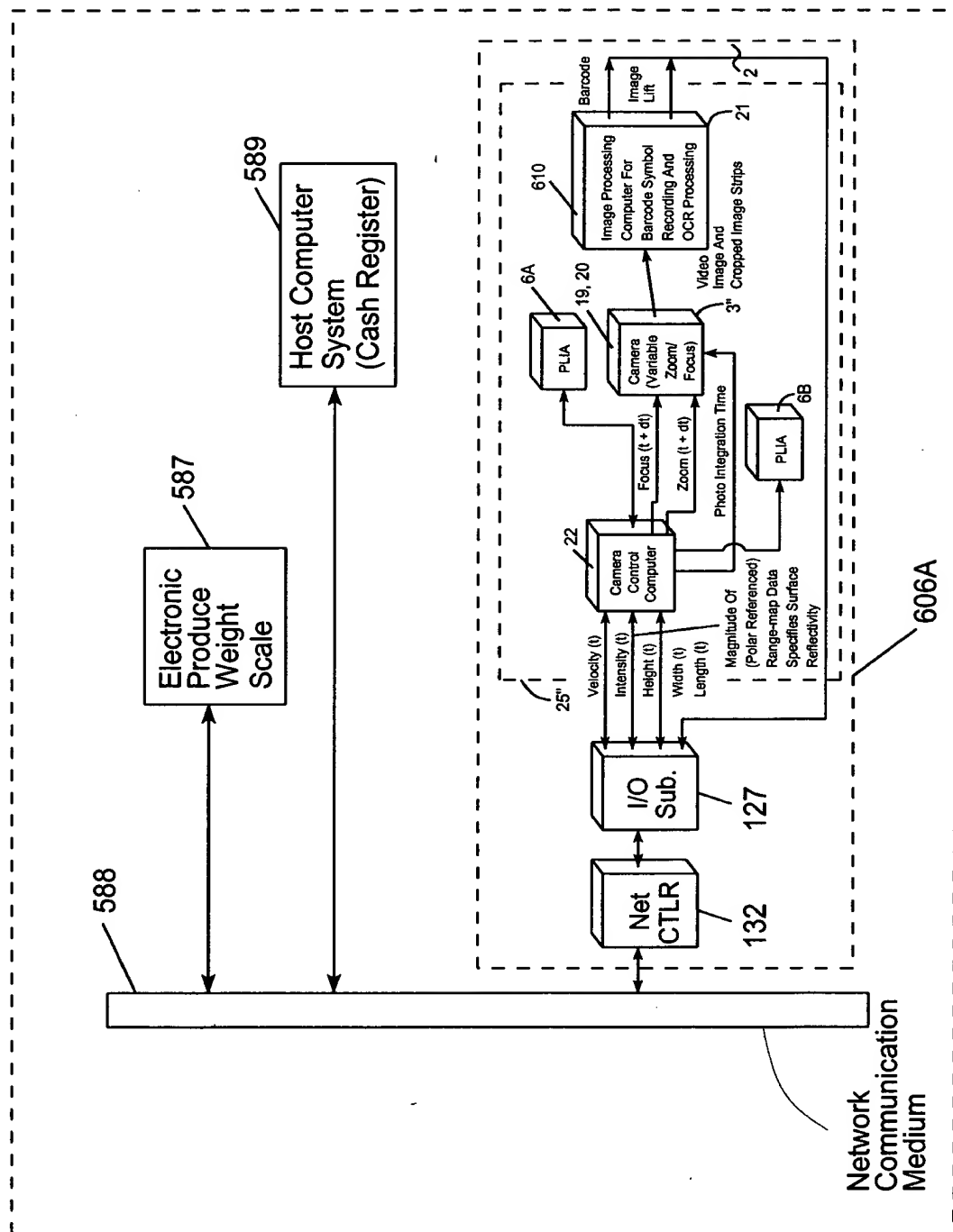


FIG. 34C1

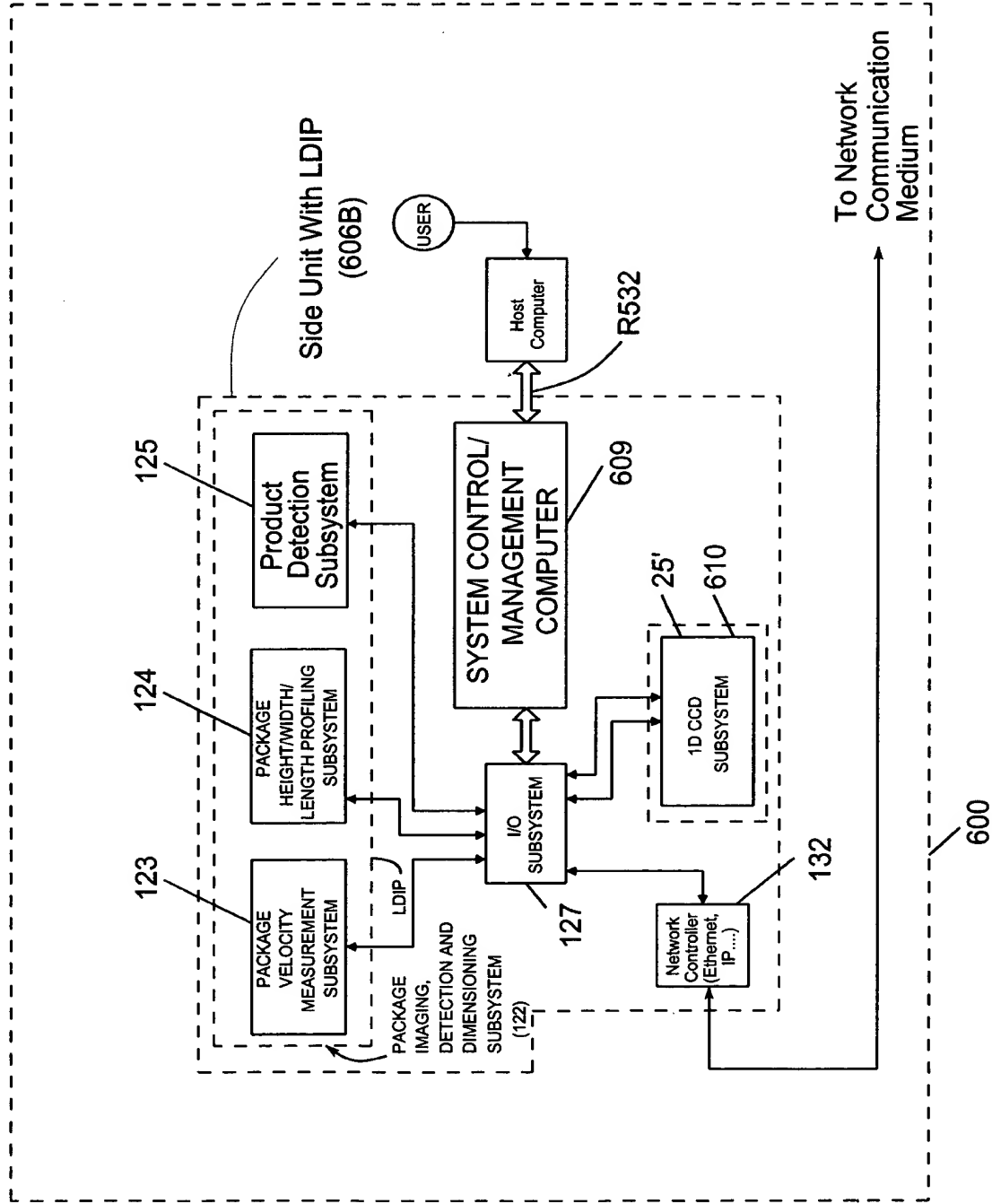
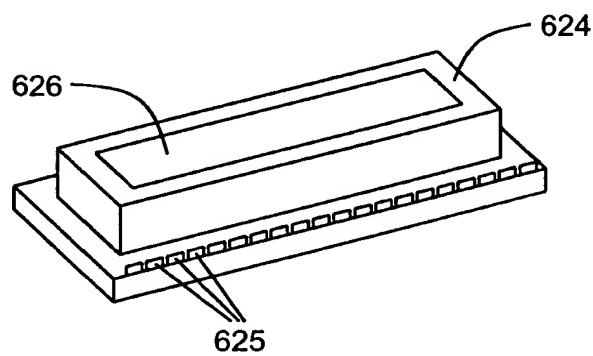
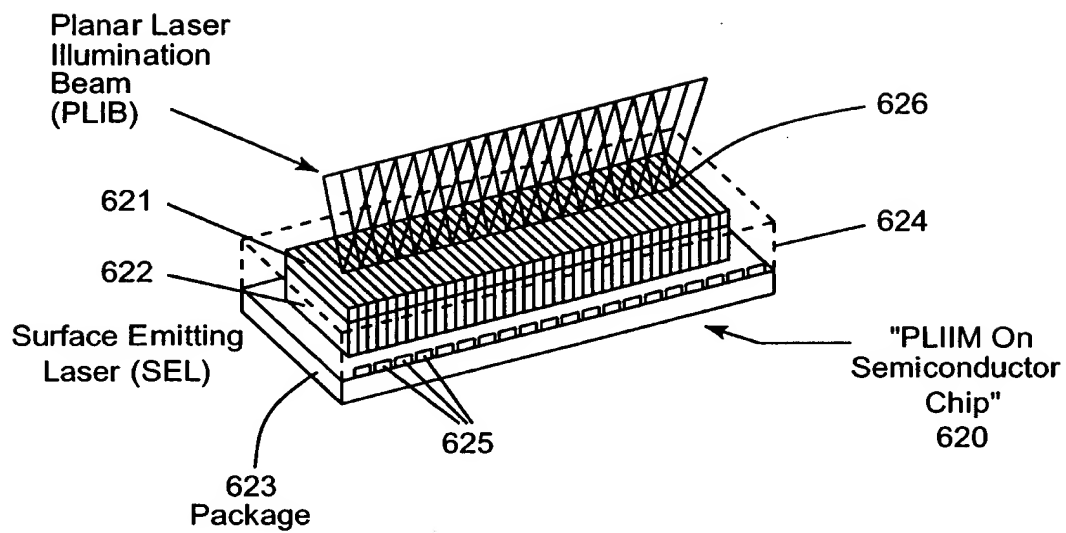


FIG. 34C2



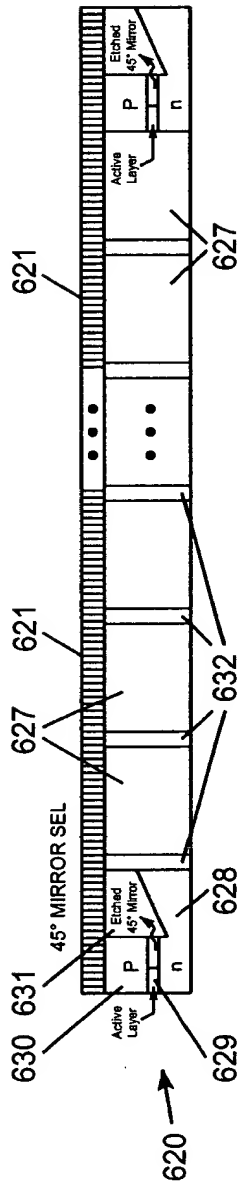


FIG. 36A

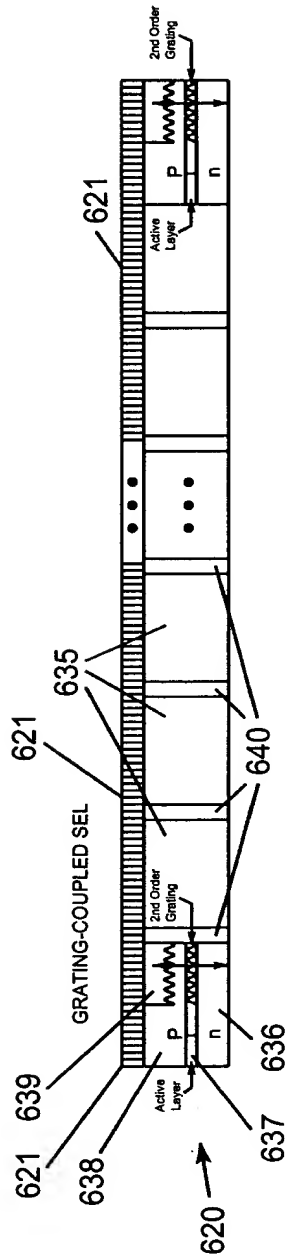


FIG. 36B

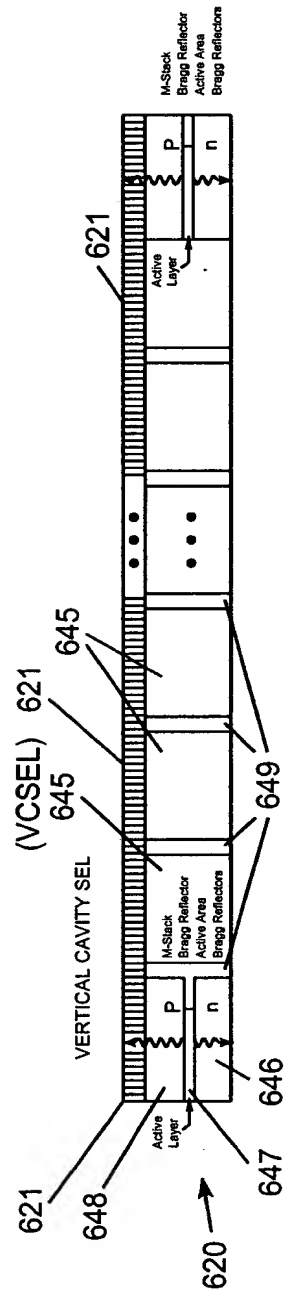


FIG. 36C

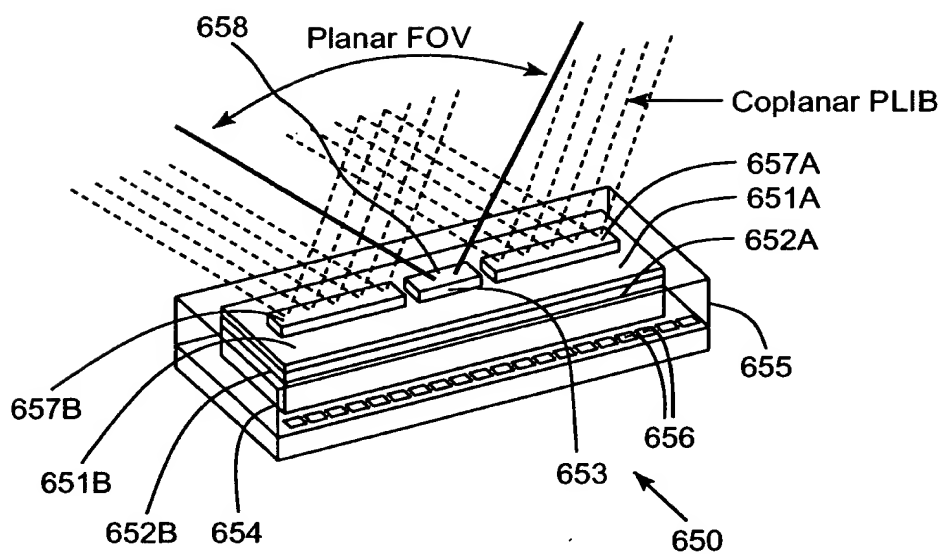


FIG. 37

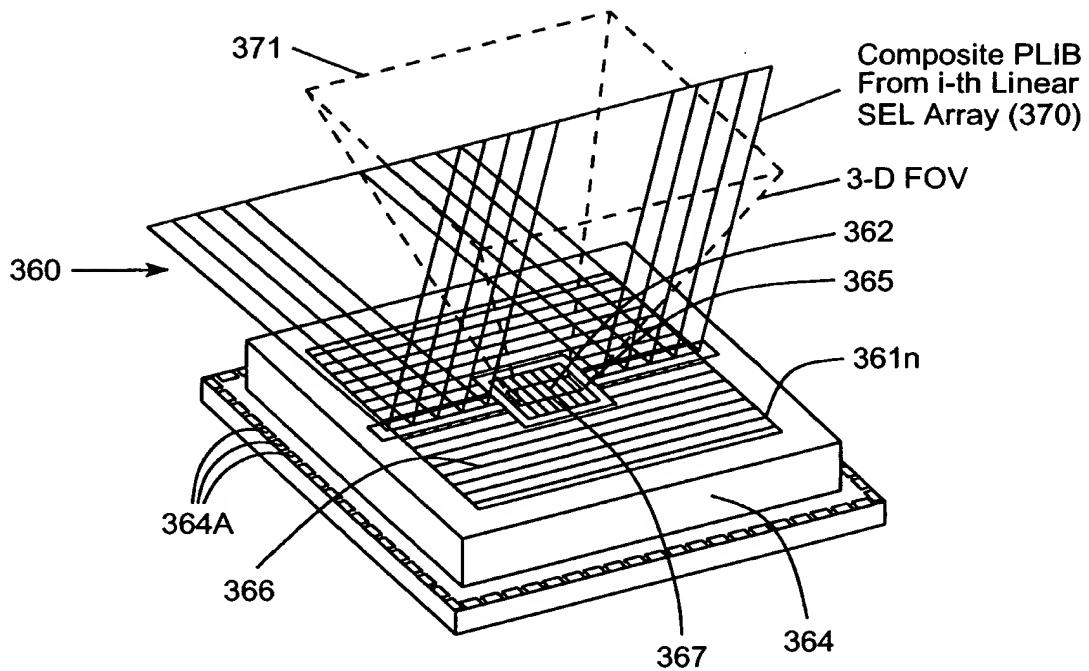


FIG. 38A

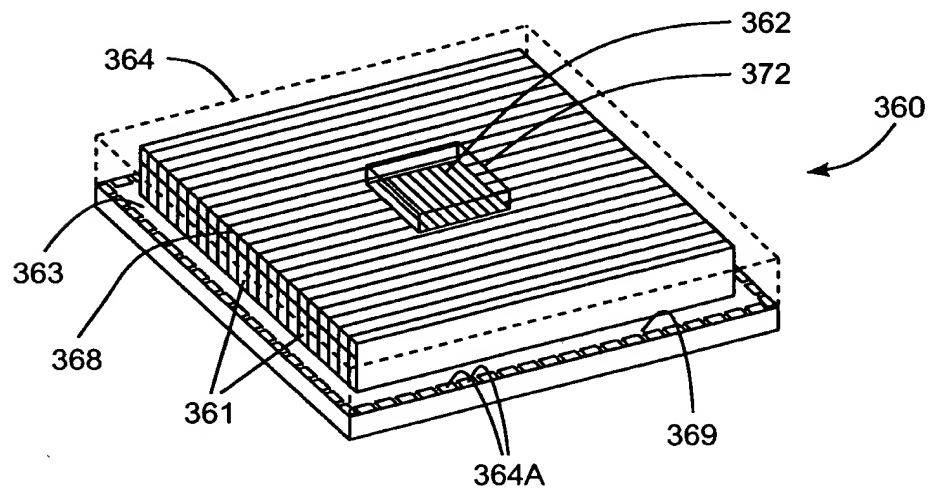


FIG. 38B